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# Control Strategy Preparation Manual for Particulate Matter

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GUIDELINE SERIES

# CONTROL STRATEGY PREPARATION MANUAL FOR PARTICULATE MATTER

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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This manual has been prepared to assist EPA, State and local agencies in the task of developing control strategies for particulate matter (PM). The manual includes a general discussion of the technical aspects of control strategy development under 40 CFR 51. The emphasis in the manual is on a brief review of pertinent facts supplemented by references to generally available technical documents. Subjects addressed include: Attainment of NAAQS; Procedures for review and development of a PM control strategy; and Question and answer sections discussing particulate emission sources and types, measurement methods, data and funds utilization, modeling, control technology, and control strategy issues. The manual also contains a glossary and subject oriented bibliography.

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# PREFACE

The Clean Air Act, as amended through 1977, provides that a State Implementation Plan (SIP) which demonstrates attainment and maintenance of national ambient air quality standards (NAAQS) in each air quality control region (AQCR) must be developed by each State. Since the years of initial development, a continuous refinement of our knowledge and understanding of air quality problems has occurred. New knowledge has led to exploration of sources of pollution, such as "fugitive dust" from construction activity, unpaved roads, etc., and "fugitive emissions" from industrial activity, which were not generally considered in the original development of SIPs. Other activities have pointed to the need for more comprehensive and long-term planning for maintenance of air quality standards in order to accommodate the growth of new sources of pollution. As a result, it is clear that a SIP must be flexible and dynamic if it is to perform adequately the function prescribed for it by the Clean Air Act. The control strategies which comprise a SIP must be designed accordingly.

This manual has been prepared to assist EPA, State and local agencies in the task of developing control strategies for particulate matter (PM). The manual includes a general discussion of the technical aspects of control strategy development under 40 CFR 51; it does not detail the specific requirements of SIP development as described in 40 CFR 51 Subpart D - "Maintenance of National Ambient Air Quality Standards Summary."

Many control strategies will be revised as a result of the determinations of SIP adequacy performed by the Agency during 1976 and required by the Clean Air Act amendments of 1977. The manual is intended to address the need for guidance in the accomplishment of this task. The emphasis in the manual is on a brief discussion of pertinent facts supplemented by references to generally available technical documents.

The policies referred to in this manual were developed before the recent passage of the Clean Air Act amendments of 1977. Due to the large scope of these amendments, it is difficult to predict how policies concerning the control of particulate matter emissions will change. Incorporated in this manual are the specific non-policy changes, such as changes in the SIP revision submission dates. As new policies develop under the implementation of these amendments, this manual will be revised to reflect these changes.

The manual is separated into ten sections. Section I provides an overview of the various factors to be considered in the development of an approvable control strategy for particulate matter (PM). Section II sets forth a step-by-step procedure that a control strategy developer should follow in preparing an approvable control strategy. Sections III - VIII provide, in question-and-answer format, a more detailed explanation of the recommended procedures outlined in Section II. Section IX is a glossary of terms used throughout the manual. Section X is the bibliography of memoranda, technical papers, etc., referred to in the manual.

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# I

# OVERVIEW OF FACTORS AFFECTING ATTAINMENT OF THE NATIONAL STANDARDS FOR PARTICULATE MATTER

The following statements summarize the pertinent facts concerning the nature and extent of the particulate matter problem and the technical information available to assist in the analysis and development of approvable control strategies for particulate matter.

1. The National Primary Ambient Air Quality Standards for particulate matter (PM) are 75 $\mu g/m^3$, annual geometric mean, and 260 $\mu g/m^3$, maximum 24-hour concentration, not to be exceeded more than once per year. The National Secondary Ambient Air Quality Standards are 60 $\mu g/m^3$, annual geometric mean, as a guide to be used in assessing implementation plans to achieve the 24-hour standard, and 150 $\mu g/m^3$, maximum 24-hour concentration, not to be exceeded more than once per year.

2. The term particulate matter (PM) represents a broad group of diverse substances. These substances can be chemically categorized as primary or secondary particulate matter. Primary particulate matter is any particulate matter that is emitted directly from a source, natural or manmade, and remains relatively unchanged chemically in the atmosphere. Secondary PM is formed in the atmosphere from gaseous precursors. Precursors are generally "pollutant gases" ($SO_2$, $NO_x$, HC) emitted from many of the same sources as the primary PM and also gaseous constituents such as ammonia from natural sources, such as decaying vegetation. PM may also be classified physically by mass fractions as a function of particle size. The "fine" fraction is usually defined as being the mass

of particulates that have an aerodynamic diameter between 0.01 and 2.0 micrometers. The coarse particulate fraction roughly encompasses those particles with an aerodynamic diameter of 2.0 to 100 micrometers.

3. Existing ambient air quality standards do not differentiate with regard to chemical composition or particle size. Studies suggest that both primary and secondary components of PM have serious health effects. EPA is still studying the need for specific air quality standards for fine and/or secondary particulates. Recent evidence suggests an approach which places greater emphasis on the control of selected categories of particulate matter such as sulfates, organics, etc., with continued reliance on the current PM standard for overall control of particulates rather than the development of a fine particulate standard.

In a recent court action, NRDC v. Train (9 ERC 1425, 2nd Cir. 1976), EPA was directed to develop an air quality standard for lead. Additional air quality standards with regard to other fractions may be developed in the future, depending on research and court action.

EPA has scheduled review and revision of the Air Quality Criteria Document for particulate matter by August 1979.

4. The Federal Reference Method for measuring particulate matter in the ambient air is the high-volume sampler. The results are expressed as the mass concentration of suspended particulates in $\mu g/m^3$. No procedures for determining equivalency of alternate methods have been developed; hence, the high-volume sampler is the only acceptable method. In 1974, 2,004 sites reported valid* (all four quarters) PM data to the Storage and Retrieval of Aerometric Data (SAROAD) system.

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*Validity refers to the fact that there are sufficient values to calculate an annual average.

5. Observed concentrations of particulate matter are sensitive to the siting of monitors. Slight changes in either the horizontal or vertical placement of the monitor may result in significant differences in ambient measurements. Studies have shown that a 10 to 25 $\mu g/m^3$ difference in measured annual air quality levels can result from moving a monitor only a few hundred feet. The development of uniform siting criteria has been considered by the Standing Air Monitoring Work Group. The Work Group document, which will be discussed in Section IV, is Air Monitoring Strategy for State Implementation Plans. EPA 450/2-77-010, June 1977.

6. Even though ambient concentrations of particulate matter on a national basis have been reduced by approximately 4% per year between 1971 and 1975, violations of national standards are still recorded in many portions of the nation. In fact, 23% of the stations reporting valid data to SAROAD in 1974 had concentrations that exceeded the primary annual standard. These sites were located within 111 of the 247 air quality control regions (AQCRs) in the nation.

7. While abatement actions scheduled under the original State Implementation Plans (SIPs) will continue to reduce ambient concentrations in a number of areas of the nation, it is now clear that some of the original SIPs are not adequate to provide for attainment and maintenance of national standards. In such areas, the SIPs will need to be revised to include either more stringent emission limitations or controls on sources which were not controlled by the original SIPs. In July, 1976, EPA officially notified 29 States, the District of Columbia and Puerto Rico that their SIPs needed to be revised for PM.

8. To the extent possible, except for the contribution of fugitive dust, it is recommended that diffusion modeling in lieu of rollback modeling be used in defining a source/receptor relationship where SIP revisions are needed. There are several models which are suggested for use in control strategy development, as discussed in Section VI. Fugitive dust problems require modified techniques not yet incorporated in these models, but suggested approaches are also discussed in Section VI.

9. In areas where emissions from stationary sources contribute to violations of national standards, emission limitations representing at least reasonably available control technology (RACT) or more stringent controls if necessary to demonstrate attainment are to be fully implemented by December 31, 1982. These plans are to be adopted and submitted by January 1, 1979.

10. With respect to individual point sources with defined emission points, reasonably available control technology (RACT) defines the lowest emission limit that a particular source is capable of meeting by application of control technology that is reasonably available considering technological and economic feasibility. RACT may represent a relatively stringent or even "technology forcing" requirement that goes beyond simple "off-the-shelf" technology. The determination of RACT may vary from source to source due to specific source configurations, retrofit feasibility, operation procedures, raw materials, and other characteristics of an individual source or group of sources.

11. Various efforts have either been completed or are underway to provide guidance on determining RACT for any particular sources. These efforts are specifically identified in later portions of this document.

12. It has been generally acknowledged that fugitive process emissions (i.e., industrial emissions which escape to the atmosphere through doors, windows, etc., but not through a primary exhaust system) were generally not included in the original SIPs. In some cases, it has been shown that fugitive emissions may be responsible for an annual air quality impact of up to 25 $\mu g/m^3$. A study on fugitive process emissions has recently been completed. The study, Technical Guideline for Industrial Process Fugitive Particulate Emissions, EPA Report No. 450/3-77-010 (Prepared by PEDCo, Environmental Inc., Cincinnati, Ohio), concentrates on the development of techniques to control industrial process fugitive particulate emissions defined as . . ."Particulate matter which escapes from a defined process flow stream due to leakage, materials charging/handling, inadequate operational control, lack of reasonably available control technology, transfer or storage." The guideline also includes techniques for estimating ambient concentrations due to these sources.

13. Numerous investigations to determine the cause of non-attainment of national standards in many areas have concluded that various fugitive dust sources are contributing significant concentrations of particulate matter. Fugitive dust is particulate matter that becomes suspended due to wind or man's activity or both. Fugitive dust from unpaved roads, construction activity, and re-entrainted particles from

paved roads have been noted as being the primary cause of non-attainment in certain areas. A study, Technical Support Document for Development of Control Strategies in Areas with Fugitive Dust Problems, conducted in Phoenix, AZ, suggests techniques for estimating fugitive dust emissions, the control available, and the costs associated with controlling such sources. The document includes proposed diffusion modeling techniques for fugitive dust in arid western U.S. regions which may be useful in the following situations:

(1) To assess the relative importance of the fugitive dust problem.

(2) To assess the need for additional stationary source control in the context of the overall problem.

(3) Give a preliminary evaluation of the potential impact of various fugitive dust control measures. This evaluation could give a preliminary assessment of the likelihood of attainment/maintenance and an initial screening of those fugitive dust control measures which appear most promising for further evaluation.

Estimates have been made concerning the air quality impact of certain sources of particulate matter. These include:

Construction Activity - Typical impact due to construction is on the order of 1 to 3 $\mu g/m^3$ increase in citywide annual averages. Primary impact is at sites within the immediate vicinity and downwind from the construction activity up to distances of one mile.

Rubber Tire Particles - Typical annual impacts of several $\mu g/m^3$ have been found with the highest impact at industrial and commercial sites. Sites located near heavy traffic areas average twice the levels at other sites.

Resuspended Dust - Annual average impact is variable, but a typical level of important residential monitors is estimated at 10 to 15 $\mu g/m^3$ and 15 to 20 $\mu g/m^3$ at commercial and industrial sites respectively. The composition of this component is mostly mineral matter and secondary PM.

Additional studies are underway to address the solution to fugitive dust problems in other areas of the U.S., and guidance is expected to be made available by September 1977.

14. States must consider the control of fugitive dust in their SIPs where it is a manmade problem, especially in large urban areas. The date for submittal of plans for the control of fugitive dust as well as other control measures is January 1979. These plans must include specific regulatory actions that may be needed to attain national standards, and may include various interagency agreements, demonstration grants to investigate possible control solutions and other actions which may be needed for an adequate control strategy.

# II

# PROCEDURES FOR THE REVIEW AND DEVELOPMENT OF A CONTROL STRATEGY FOR PARTICULATE MATTER

## Scope and Objectives

The development of an air pollution control strategy designed to attain and maintain the National Ambient Air Quality Standards (NAAQS) requires an analysis of current and possible future air quality problems. It is the objective of this section to briefly present the quantitative and qualitative procedures used in developing an acceptable plan for the control of particulate matter. The amount of work involved in each step will vary from area to area depending on available data, magnitude of the non-attainment or maintenance problem, types of emission sources, etc. These steps can be summarized as follows:

STEP 1: Review available air quality data for PM to determine if national standards are not being attained or will not be maintained.

STEP 2: Determine the validity of available air quality data.

STEP 3: Review valid air quality data to determine their representativeness and their limitations.

STEP 4: Determine if valid air quality data are of such concentrations that a further analysis of existing and anticipated emissions data should be conducted.

STEP 5: Determine the boundaries of the geographic area to be considered in the analysis.

STEP 6: Determine the sources of particulate matter emissions within the area and calculate the emissions from each source.

STEP 7 : Determine the spatial distribution of emission sources throughout the area of analysis and allocate emissions accordingly.

STEP 8 : Using a recommended atmospheric diffusion model, determine the baseline source/receptor relationship for the area.

STEP 9 : Determine the degree of control that will occur from full compliance with adopted regulations.

STEP 10: Determine the expected increase of emissions due to growth profiles, generally for the next 20 year period.

STEP 11: Factor growth into diffusion model to predict future air quality.

STEP 12: If additional control measures are needed to provide for attainment and maintenance, determine the effectiveness of various emission control measures on reducing ambient PM levels.

STEP 13: Determine the most expeditious date of attainment, which must be before December 31, 1982.

Detailed explanations of the foregoing steps now follow. More detail and background on this procedure can be found in Air Quality Analysis Workshop, Volume I - Manual, EPA-450/3-75-080a, November 1975.

STEP 1 - Review available air quality data for PM to determine if sufficient data are available to provide evidence that the national standards are not being attained or will not be maintained. Comparison of measured ambient levels with the NAAQS is the primary means of determining whether air quality requirements are being achieved. Where the NAAQS are being exceeded, the reason for the high levels must be determined and the need for corrective action evaluated. Valid data from at least one site with one year of data should be available. However, 3 years or more of data are preferable. Comparison of data over a period of years for a specific area can indicate developing air quality trends. In areas exceeding the NAAQS, the trend can be used as a monitor of progress in attaining the standards. In areas where NAAQS are being met but where growth and development are occurring, upward trends in measured concentrations may dictate a reevaluation of the need for specific maintenance measures in addition to existing stationary source and mobile source programs.

Data should also be available from areas of expected maximum concentrations; however, lack of such data should not preclude the development of a control strategy if available data indicate valid violations of national standards. Where data are limited, predictive models are available to estimate ambient PM air quality levels.

STEP 2 - If ambient air quality data indicate a potential attainment or maintenance problem, review the data to determine its validity.

(a) Determine if a satisfactory measurement procedure was used to collect the data being reviewed. Insure that each monitoring site uses a high volume sampling device, as described in 40 CFR, Part 50, Appendix B. The high-volume method is the Federal Reference Method for total suspended particulates and is the only acceptable method. No procedures for determining equivalency of alternative methods have been developed; so all other methods are to be considered unacceptable.

(b) Analyze the available air quality data to assure their validity and reliability. Determine if the data were collected by monitors that are properly operated, maintained and calibrated, and if adequate quality control procedures were utilized to assure validity of data.

Several guidelines have been developed to assist in the review and validation of air quality data:

I. Guidelines for the Evaluation of Air Quality Data, OAQPS No. 1.2-015, Feb. 1974.

II. Guidelines for the Evaluation of Air Quality Trends, OAQPS No. 1.2-014, Feb. 1974.

III. Guidelines for Air Quality Maintenance Planning and Analysis, Volume 11, Air Quality Monitoring and Data Analysis, OAQPS No. 1.2-030, Sept. 1974.

IV. Designation of Unacceptable Analytical Methods of Measurement for Criteria Pollutants, OAQPS No. 1.2-018, Sept. 1974.

NOTE: The purpose of Step 2 is to insure that the data which will be used as the basis of a control strategy are valid, or can reasonably be assumed to be valid. If it is believed that the data are questionable and factors exist that could reasonably challenge the data validity, then such data should not be used as the basis of a control strategy. If on the other hand, all reasonable measures have been followed in the collection of the data, and unless the validation efforts prove the data to be invalid, then such data should be assumed valid and usable.

STEP 3 - Review the valid air quality data to determine their representativeness and its limitations.

(a) Determine the representativeness (i.e., how well the data reflect the air pollutant concentrations caused by emission sources in the area of interest), as suggested by the location of the monitor, and whether the measured concentrations are widespread or restricted to the local area. This will aid in developing regulations which will be aimed at the true cause of the violation. For example, if a monitor is influenced predominantly by street dust, a new control regulation which addresses stationary sources would be ineffective in reducing levels at that monitor; only controls aimed at reducing street dust would reduce these levels. Thus, in order to formulate appropriate measures later in the development of the control strategy, it is important to define as well as possible the sources which influence the monitor.

(b) Identify unusual conditions which may have influenced the data. Events such as dust storms, forest fires, control equipment malfunctions or shutdowns can temporarily cause abnormally high ambient concentrations. EPA regulations (40 CFR Part 51.12(d)) allow states to discount abnormal measurements which occurred during such unusual conditions. Data collected during unusual conditions should not be used as the basis for increasing the stringency of control regulations.

STEP 4 - Determine if valid air quality data are of such concentrations that a further analysis of existing and anticipated emissions data should be conducted. This analysis should be conducted if ambient air quality levels are equal to or exceed national standards. Also, in those areas where growth of new emission sources is expected, the analysis should be conducted even if national standards are being attained on a marginal basis.

STEP 5 - Determine the boundary of the geographic area to be considered in the analysis. From available data, determine the geographic area where national standards are violated or are anticipated to be violated due to growth of emission sources. It is not necessary to use an entire AQCR or county. The area does not have to be a political entity. Some consideration should be given to political boundaries, however, since the regulations may be enforced by local governments. Although some advantages accrue to the use of a commonly identified geographical area, as long as the area is clearly defined, any area is appropriate for development of a control strategy. The area of concern should be "future-oriented," in that strong consideration should be given to growth of emission sources. A diffusion model analysis may be useful in defining the boundaries of the study area (See STEP 8).

STEP 6 - Determine the sources of particulate matter emissions in the area and calculate the emissions from each source.

The air pollutant emission inventory forms the basis of making an assessment of air quality management problems. Because of growth, development, and regulatory programs applied to pollutant producing activities, the emission inventory can be expected to change with time, hence it will generally be necessary to update the inventory.

The inventory should be updated to the most recent time period for which adequate data are available. All portions of the inventory should be adjusted to the same year. Further, the emission inventory should cover the same time period as that represented by the air quality data. In other words, if 1975 air quality data are to be used in the analysis, then 1975 emission data should be used.

The emission data which are generally needed are generally divided into six major source categories and various subdivisions as indicated in Table 1. Point sources are generally any stationary sources which may be specifically defined (or restricted) by an emission limit or constraint. An area source is a collection of sources whose individual emission rates are small but whose collective impact may be large. Exceptions to the point source definition would be large boilers using residual fuel oil and apartment house incinerators such as those found in New York City. These are subject to "specifically defined emission limits," but are best treated as area sources in the analysis. Table 2 lists the general types of information needed for each source type.

There are several special considerations that will influence the development of an emission inventory. These include:

a. Intent of Inventory - It is important to realize that there are various purposes for which the emission data are needed. The two basic purposes are (1) to assess where the ambient PM problem originated, and (2) to determine the emission reduction impact of various possible control regulations on source emissions. Data should be collected to satisfy both objectives.

## TABLE 1 - EMISSION SOURCE CATEGORIES

| Source Category | Subdivisions | Source Description |
|---|---|---|
| Industrial Process | Chemical manufacture<br>Food/agriculture<br>Primary metals<br>Secondary metals<br>Mineral products<br>Petroleum industry<br>Wood products<br>Evaporation<br>Metal fabrication<br>Leather products<br>Textiles<br>Inprocess fuel<br>Other | Point |
| Fuel Combustion | Internal combustion<br>External combustion | Point, Area |
| Transportation | Highway Vehicles<br>Light duty gasoline autos<br>Light duty gasoline trucks<br>Motorcycles<br>Heavy duty gasoline trucks<br>Heavy duty diesel trucks<br>Off-highway vehicles<br>Rail locomotives<br>Vessels<br>Aircraft | Area |
| Electricity Generation | | Point |
| Incineration | | Point, Area |
| Miscellaneous | Solvent evaporation<br>Fires<br>Fugitive dust | Point, Area |

Source: Air Quality Analysis Workshop Volume 1--Manual, op. cit., page 41.

Table 2 - Emission Source Data Required

| Source Type | Data Desired |
|---|---|
| Point | Pollutant emission rates<br>Process activity - type of process, process weight rate<br>Control equipment - type and efficiency<br>Stack parameters<br>Geocoded location<br>Compliance information<br>Land area[a]<br>Employment[a] |
| Area | Pollutant emission rates<br>Area geometry<br>Area geocoded location<br>Area source type and activity level |

[a] May be useful for certain strategy considerations.

Source: Air Quality Analysis Workshop Volume 1--Manual, op. cit., page 42.

b. Level of Detail - The level of detail in the inventory must be suitable to the analysis to be performed. It is not adequate to develop an inventory of a source category, for example, with crude approximation methods if the analysis will require a detailed consideration of that source's impact on air quality. The most detailed level should be used on major sources that are expected to impact significantly on air quality. Less detailed procedures may be used for minor sources. Recent work on the development of Air Quality Maintenance Plans includes a detailed discussion of inventory updating procedures. The reader is referred to the Air Quality Analysis Workshop Volume I - Manual, op. cit., page 44, and Guidelines for Air Quality Maintenance Planning and Analysis, Volume 7, Projecting County Emissions, OAQPS No. 1.2-026, January 1975, for a detailed discussion of inventory updating procedure.

c. Actual vs. Allowable Emissions - In the development of the emission inventory, it is important to keep in mind that the desired inventory is one that represents, as closely as possible, the actual situation. In this light, the effect of the following items must be considered:

Variances granted.
Non-compliance.
Compliance schedules.
Improved performance.
Seasonal operation.

The incorporation of stack test data into the inventory whenever possible will ensure that these considerations are included. For sources not yet in operation or for the projected inventories, the first approximation of assuming that sources will just meet the emission regulations will be adequate; however, where information is available to the contrary, it should be included.

d. Applicability of strategies - In developing the emission inventory, it is necessary to foresee what type of information might be needed to evaluate alternative control strategies. If, for example, it is felt that a strategy based on emission density (i.e., emissions per unit area) will receive consideration, then it is necessary to know what land area is currently owned by the sources in the inventory. If a strategy will be directed toward a certain type of process activity, it will be necessary to know which sources use that process.

Comprehensive guidelines are available on procedures for calculating emissions from various sources. The reader is referred to Guide for Compiling a Comprehensive Emission Inventory, EPA/APTD 1135, March 1973. Also, EPA Document AP-42 with Supplements 1-6, April 1976, contains emission factors for estimating emissions from numerous sources.

Modeling of fugitive PM sources requires considerably more detail in the emissions inventory data with respect to the physical characteristics of particulates. In this regard, merely because an emission inventory is modified to account for fugitive dust and fugitive emissions, it will in all likelihood not be amenable for use in existing diffusion models. This is because the model to be used must be modified to properly consider fugitive PM, e.g., particle size and density distributions must be suitable for such considerations as tilt of the plume, gravitational settling, surface deposition, wet removal and re-entrainment of settled PM by wind. Current model improvement projects are underway to provide techniques to handle these problems, and guidance should be available by the Fall of 1977.

STEP 7 - Determine the spatial distribution of emission sources throughout the area of analysis and allocate emissions accordingly.

To this point, the focus of the emission inventory portion of the analysis has been to generate the emission pattern generally for the entire area under study such as a county. Prior experience with air quality management has shown that countywide spatial resolution of emissions is usually too coarse for particulate matter. The effects of individual sources are generally localized in impact and an adequate analysis and control strategy development relies on a spatial resolution of emissions. The identification of the level of spatial resolution is a function of several variables:

Available data.
Anticipated problem areas.
Anticipated problem sources.
Applicability to modeling.
Applicability to strategies.
Resources available.

The principle constraint on spatial resolution is the available data. If the information is on too coarse a geographical scale, then an effort is required to improve the data base. The spatial resolution should be fine enough to distinguish special problem areas and special problem sources. As an illustration, it is not possible to treat a major metropolitan city in its entirety. The spatial resolution should be able to distinguish the Central Business District (CBD) from industrial parks and from residential neighborhoods. Further, the applicability of control strategies is an important consideration and is one of the prime reasons for using a sub-county resolution. In some cases, control strategies may not be appropriate for application to an entire county and the analysis should be sensitive to these considerations.

In order to provide for the needed spatial distribution of emission sources, it is necessary to establish a master grid system for the area of analysis. There are a variety of rectilinear coordinate systems that can be used in developing a master grid. It is desirable, however, to use Universal Transverse Mercator (UTM) coordinates, which are universally available on U.S. Geological Survey maps. The UTM coordinates offer the widest generality and applicability. The only translation problem occurs when an analysis area lies between two UTM zones where the abscissas are not continuous. This is treated by means of careful bookkeeping.

The master grids chosen should, in general, be square with variations in size depending on the resolution of the subcounty areas. The smallest grid square chosen should be 1 km x 1 km. Smaller grids should be considered only if the necessary data are available. A "micro-inventory" around monitoring sites may be needed to establish source receptor relationships, such as in the case of the larger size fugitive dust particles. The largest grid square chosen should be 8 km x 8 km. Larger grids would cancel some of the subcounty resolution already achieved. The use of dispersion models dictates certain limits on the size and number of grids and hence on the spatial resolution. Although the models can theoretically treat any size grid, the accuracy suffers if the grids are too large and computation expense increases if they are too small.

Once the master grid has been established, the calculated emissions can be allocated throughout the area. There are basically three procedures for determining spatial allocations of emission-producting activity:

Locate the activity directly from available data,

Develop a distribution function of activity using an allocation parameter (e.g., population), and

A combination of the above procedures.

Volume 13 of the AQMA series (Allocating Projected Emissions to Sub-County Areas) outlines the recommended procedures for these methods as applicable to each of the source categories. The sources that can be spatially located directly are, existing and new:

Industrial point sources.
Commercial/Institutional point sources.
Steam-electric power plants.
Limited access highways.

If the source activity cannot be located directly, a distribution function can be used to allocate emissions. A simple model would start with the knowledge of the activity on a countywide basis and then distribute this activity to each subcounty area based on that area's proportion of some county wide parameter, such as population or employment. The types of distribution functions that can be developed include: population, dwelling units, dwelling units by fuel use, employment, land use, and area. More detailed guidance on the subject of allocating emissions to subcounty areas is available in the AQMA guidelines:

(a) Volume 2, Plan Preparation, OAQPS No. 1.2-021, July 1974.

(b) Volume 7, Projecting County Emissions, OAQPS No. 1.2-026, Jan. 1975.

(c) Volume 13, Allocating Projected Emissions to Subcounty Areas, OAQPS No. 1.2-032, Nov. 1974.

Until July 1, 1979, allocation of future emissions for major new point sources may be discounted where EPA's emission offset policy is applicable. This policy does not prohibit major new or expanded sources in areas that exceed NAAQSs, provided that the new effect of the new emissions together with reductions from existing facilities beyond that required by the SIP does not exacerbate current primary standard violations, but instead contributes to reasonable progress in attaining such standards. Due to the Clean Air Act amendments of 1977, SIPs must be submitted by January 1, 1979, to demonstrate attainment by 1982, and there will be a change in the usage of the offset policy after July 1, 1979. The offset policy may be incorporated into the SIP in nonattainment areas as part of the process to demonstrate attainment and allow for new growth by reducing emissions from existing sources. See page VIII-13 for a discussion of EPA's emission offset policy.

NOTE: The procedures outlined in STEP 6 should not be viewed as necessarily separate and distinct from the development of the baseline inventory described in STEP 7. In many instances these techniques can be used in parallel rather than in series with the previous methods.

STEP 8 - Using recommended atmospheric diffusion model, determine the baseline source/receptor relationship for the area.

An atmospheric diffusion model is used to convert the air pollutant emission data into ambient air pollutant concentration estimates. The model is an analytical tool that helps the air quality analyst determine the effectiveness of his control strategies.

In the task of developing a control strategy, the choice and use of a model is a key step. Some means of relating air quality, meteorology, and emissions to appropriate control regulations must be used, and this necessitates the development of a "source/receptor" relationship which is as accurate as possible. Caution must be used, because atmospheric simulation models are useful only if the user understands their applications and limitations. The services of air pollution meteorologists and engineers are especially important in the application of the more sophisticated models and in locales with complex meteorology or topography.

The choice of which model to use is a function of many considerations including pollutant, averaging time, data requirements, model output, ease of use, availability, reliability, and applicability to air quality analysis. A description of the models most frequently used by EPA is presented in Guidelines for Air Quality Maintenance Planning and Analysis, Volume 12: Applying Atmospheric Simulation Models to Air Quality Maintenance Areas, OAQPS No. 1.2-031. Sept. 1974; an updated listing is presented in the Guideline on Air Quality Models and Associated Data Bases, February 1977 (Draft).

Techniques for fugitive dust modeling are currently under study by EPA. A discussion of this issue is included on page VI-6.

A useful form of output for those models that can compute concentrations at any point is the isopleth or line of constant concentration. If the computations are made at a large enough number of receptor points, then the isopleths are easily drawn by interpolating between adjacent points. The use of isopleths is an extremely valuable tool in visualizing the general air quality situation and identifying "hot spots" (See Figure 1).

In determining the impact of various sources on air quality at a given location, it is worthwhile to develop a list of the contributions of each source to the calculated concentration at a given receptor. Since all of the recommended models made use of the principle of superposition in that the concentration is calculated as the sum of the emissions dispersed from each individual source, it is conceptually straightforward to develop such a list. The AQDM model has a routine incorporated into it that prepares such a list with no additional burden on the user. This information is extremely useful in control strategy development and analysis.

STEP 9 - Determine the degree of control that will occur from full compliance with adopted regulations.

Consider the impact on PM emissions (both increases and decreases) that may result from (a) source compliance with adopted particulate

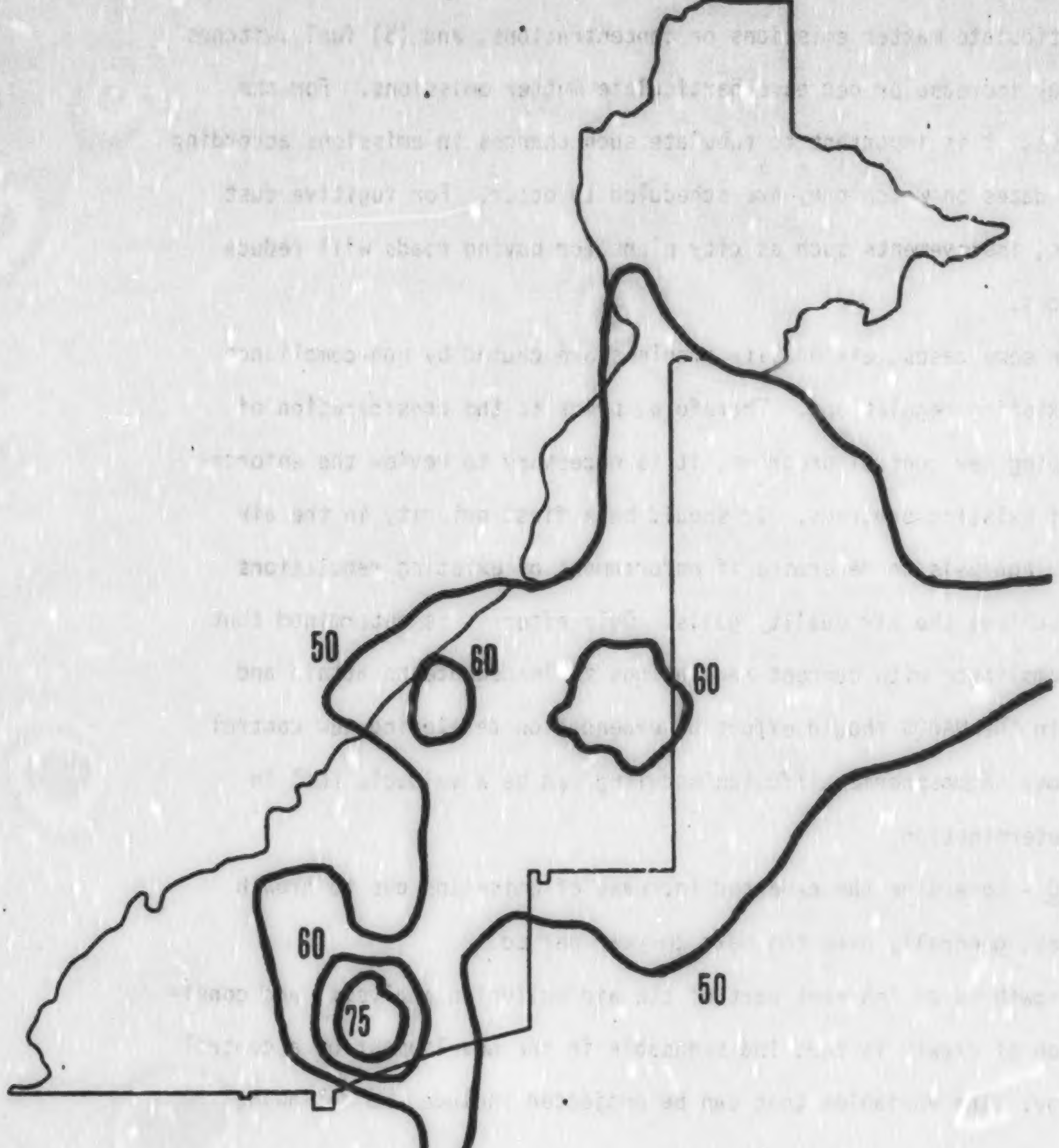
50
60
60
60
75
50

Figure 1. An Example Use of Isopleths.

matter control regulations, or the regulations adopted primarily to minimize emissions of another pollutant but which may have an effect on particulate matter emissions or concentrations, and (b) fuel switches that may increase or decrease particulate matter emissions. For the analysis, it is important to tabulate such changes in emissions according to the dates on which they are scheduled to occur. For fugitive dust sources, improvements such as city plans for paving roads will reduce emissions.

In some cases, air quality problems are caused by non-compliance with existing regulations. Therefore, prior to the consideration of developing new control programs, it is necessary to review the enforcement of existing programs. It should be a first priority in the air quality analysis to determine if enforcement of existing regulations could achieve the air quality goals. Only after it is determined that full compliance with current regulations is inadequate to attain and maintain the NAAQS should effort be expended on developing new control programs. Atmospheric diffusion modeling can be a valuable tool in this determination.

STEP 10 - Determine the expected increase of emissions due to growth profiles, generally over the next 20-year period.

Growth is an inherent part of the air pollution analysis, and consideration of growth is thus indispensable in the development of a control strategy. The variables that can be projected include the following:

Industrial process activity,
Fuel consumption,
Transportation activity,
Electricity demand,
Solid waste generation, and
Miscellaneous emission-producing activity.

In addition, the temporal and spatial distribution of these variables (e.g., when new plants will come on line and where they will be located) is important to the air quality analysis. In most situations, projections of these parameters are not available or are available only on a cruder scale than needed for an adequate air quality analysis, especially in attainment/maintenance problem areas. Reliance must then be placed on surrogate variables such as population, employment, land-use, earnings, and others that are projected with reasonable accuracy and precision and that can then be transformed into growth factors for the desired variables.

The information needed to develop growth factors originates from Federal agencies, State and local governments, and private business interests. Fairly specific information can be obtained from State and local planning agencies and this is generally the recommended source for such data. If the data are unavailable from local agencies, various Federally funded planning programs should provide the growth projections. These include: Planning under (1) Section 701 of the Housing and Urban Development Act of 1974, (2) the Coastal Zone Management Act of 1972, (3) the Federal Aid Highway Act of 1962 (as amended) and the Urban Mass Transportation Act of 1964 (as amended), and (4) Section 208 of the Federal Water Pollution Control Act Amendments of 1972. Also OBERS projections of economic activity in the U.S., prepared for the U.S. Water Resources Council provides projections on the basis of Standard Metropolitan Statistical Areas.

Various guidelines have been prepared with regard to obtaining and projecting growth in emissions and allocating such growth. These techniques are too detailed to summarize here. The reader is referred to various Air Quality Maintenance Guidelines on the subject:

(a) Volume 2, Plan Preparation, OAQPS No. 1.2-021, July 1974.

(b) Volume 7, Projecting County Emissions, OAQPS No. 1.2-026, Jan. 1975.

(c) Volume 13, Allocating Projected Emissions to Sub-county AQMA, OAQPS No. 1.2-032, Nov. 1974.

(d) Appendices A and B, Volume 13, OAQPS No. 1.2-032, March 1975.

(e) Volume 13b, Accounting for New Source Performance Standards in Projecting and Allocating Emissions - Hypothetical Example, OAQPS No. 1.2-032, Jan. 1975.

STEP 11 - Factor growth into the diffusion model to predict future air quality. This will allow predictions of the effect of anticipated growth in an area on air quality during specified future periods, and aid in selection of control strategies to attain/maintain air quality standards throughout the periods. The model will indicate the reasons for future problems in meeting the standards such as: point sources, area sources, land use, or growth.

STEP 12 - If additional controls are needed to provide for attainment and maintenance, determine the effectiveness of various emission control measures on reducing ambient PM levels.

When the results of the diffusion modeling analysis indicate that control measures above and beyond the existing regulations are needed to attain and maintain the NAAQS, then an additional analysis will be needed to examine the effectiveness of various types of control measures. Traditional air pollution control programs have relied on technological controls on stationary sources to generally achieve desired air quality levels. Technological controls are the controls that require emission reductions from specific source categories through the addition of flue-gas cleaning devices, changes in process method or equipment, or fuel substitution. In some cases, in order to attain and maintain NAAQS, it may be necessary to require additional non-traditional considerations such as land use and transportation planning measures. In choosing strategies for evaluation, both options should be considered through the use of diffusion modeling where possible; however, since land use control measures are in general significantly more difficult to implement and enforce, the use of technological controls should be given first consideration in strategy choice.

Specifically, if current regulations do not require existing stationary sources to install reasonably available control technology, then such controls should be required where they are needed to provide for attainment and maintenance of national standards. Use of this strategy should be considered in light of the potential hardships that might be created by land use or transportation controls.

Use of the modeling results from STEP 11 provides information on the magnitude and geographical extent of the control measures needed. In general, more than one option should be considered for each problem situation. This will give the control agency a perspective on the range of possibilities that could be employed to attain and maintain the NAAQS. It also gives the agency a contingency plan in the event that a particular option is found to be unacceptable at some later point. It should be recognized that control strategies need not be applied uniformly across the study area. Certain sub-areas may require stricter controls on different types of sources.

The coordinated effort between air pollution control, regional planning, transportation planning, and other groups is an underlying assumption for the entire air quality analysis system. The agency taking the lead role in the analysis must consult with other groups as necesary. The choice of strategies for evaluation is one of the most crucial points at which this consultation takes place. Some strategies may be eliminated on the basis of social, economic, or institutional constraints without the necessity of a detailed evaluation of these considerations. Agencies participating in the air quality analysis should have the experience to know which options are unacceptable for the study area.

STEP 13 - The State must determine the most expeditious date for attainment, which must be before December 31, 1982.

# III

# QUESTIONS CONCERNING SOURCES AND TYPES OF PARTICULATE EMISSIONS

QUESTION - What is the typical composition of urban PM? In other words, if one were to analyze the material on a high-volume filter, what would one find?

ANSWER - Recently a number of hi-volume filters collected in 14 different cities were analyzed by optical microscopy. These samples were collected at areas of various land use categories within the cities to determine the "typical" composition characteristics of urban PM. The results are shown in Table 3. As can be seen, minerals and combustion products are the major categories with approximately 65% and 25% of the total PM being comprised of these components respectively. It should be noted that in undeveloped or rural areas, the mineral portion of PM is significantly high (i.e., approximately 90%).

The particle size and chemical composition of PM are important. Optical microscopy does not "see" particles less than 1-2 micrometers in diameter. Thus, a chemical analysis and accompanying particle sizing would provide the most revealing information about the composition of PM. Figure 2 illustrates both the general chemical makeup and particle size distribution of PM in the air. The plot is constructed so that the area under any section of a curve is proportional to the concentration in that size range. It is clear that very fine particles

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## Table 3. COMPOSITE SUMMARY OF FILTER ANALYSES BY SITE CLASSIFICATION[a]

| Site classification | Commercial | | Residential | | Industrial | | Undeveloped | |
|---|---|---|---|---|---|---|---|---|
| No. of filters | 114 | | 90 | | 71 | | 11 | |
| No. of sites | 29 | | 21 | | 19 | | 5 | |
| Average concentration, μg/m³ | 120 | | 92 | | 166 | | 86 | |
| | Quantity, percent | | Quantity, percent | | Quantity, percent | | Quantity, percent | |
| Components | Average | Range | Average | Range | Average | Range | Average | Range |
| Minerals | (63) | 6-99 | (65) | 3-99 | (62) | 9-96 | (90) | 79-99 |
| Quartz | 28 | 2-80 | 31 | <1-84 | 27 | 2-70 | 32 | 15-60 |
| Calcite | 20 | 1-75 | 18 | 2-70 | 20 | 0-93 | 40 | 10-60 |
| Feldspars | 6 | 0-35 | 4 | 0-20 | 4 | 0-45 | 3 | <1-4 |
| Hematite | 9 | 0-45 | 12 | 0-65 | 10 | 1-50 | 15 | 5-50 |
| Mica | <1 | 0-6 | <1 | 0-15 | <1 | 0-6 | <1 | |
| Other[b] | <1 | 0-5 | <1 | 0-5 | 1 | 0-46 | | |
| Combustion Products | (26) | 2-86 | (25) | 3-84 | (30) | 1-89 | ( 8) | 1-18 |
| Soot: | | | | | | | | |
| Oil | 8 | 0-86 | 9 | 0-63 | 6 | 0-40 | 5 | 1-10 |
| Coal | 4 | 0-34 | 5 | 0-52 | 6 | 0-40 | 2 | <1-4 |
| Misc. soot[b] | 7 | 0-84 | 3 | 0-77 | 7 | 0-88 | | |
| Glassy fly ash | 4 | 0-55 | 6 | 0-66 | 7 | 0-76 | 1 | <1-4 |
| Incinerator fly ash | 3 | 0-45 | 1 | 0-20 | 3 | 0-45 | <1 | |
| Burned wood | <1 | | <1 | 0-1 | <1 | 2-10 | <1 | |
| Burned paper | <1 | | <1 | 0-1 | | | <1 | |
| Magnetite | <1 | | <1 | 0-8 | 1 | 0-15 | | |
| Carbon black | | | <1 | 0-19 | | | | |
| Other[b] | | | <1 | 0-15 | <1 | 0-12 | | |
| Biological Material | ( 2) | 0-47 | ( 4) | <1-90 | ( 2) | 0-33 | ( 1) | <1-4 |
| Pollen | 1 | 0-45 | 2 | 0-30 | 1 | 0-25 | <1 | |
| Spores | <1 | 0-2 | <1 | 0-3 | <1 | | <1 | 0-2 |
| Paper | <1 | 0-2 | <1 | 0-3 | <1 | 0-2 | <1 | |
| Starch | <1 | 0-10 | <1 | 0-5 | <1 | 0-10 | <1 | |
| Misc. plant tissue | 1 | 0-17 | 2 | 0-80 | 1 | 0-7 | 1 | 0-3 |
| Leaf trichomer | | | | | <1 | 0-6 | | |
| Miscellaneous | ( 9) | 0-50 | ( 6) | 0-28 | ( 6) | 0-45 | ( 1) | <1-6 |
| Iron or steel | <1 | 0-4 | <1 | 0-2 | 1 | 0-25 | <1 | |
| Rubber | 9 | 0-50 | 6 | 0-28 | 5 | 0-45 | 1 | 0-6 |
| Other[b] | <1 | 0-10 | <1 | 0-10 | <1 | 0-15 | | |

[a] Excludes all NASN filters

[b] For specific composition of misc. soot and other components, refer to the Composite Summary of Filter Analyses table for the individual cities

Note: In reviewing the data, it is important to keep in mind that the technique used to compile the information is a semiquantitative technique. Considerable variability in results is not uncommon when the same sample is reviewed by different microscopists.

Source: National Assessment of the Urban Particulate Problem, op cit. pg. 154.

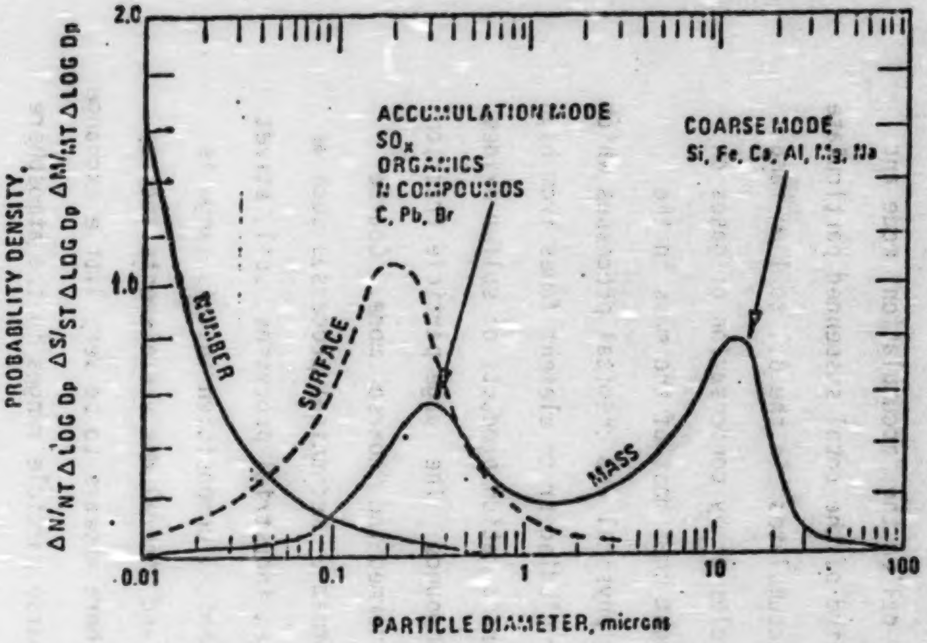


Figure 2. Normalized particle size distributions showing typical grouping of major chemical components.

Source: "Regulatory and Technical Control Strategies for Fine Particulates", Padgett, J. and Bachmann, J. D., U.S. EPA, Research Triangle Park, NC.

make up most of the total suspended particulate in terms of numbers of particles and surface area. The mass (inferred from volume) shows a bimodal distribution.

The distinct minimum at about 2 µm between the two modes provides a convenient size classification for atmospheric particles. The size range between 0.1 and 1.0 µm is called the "accumulation" mode and typically makes up about one third of the total suspended particulate mass. Fine particulate mass "accumulates" in the 0.1 to 1 µm range by coagulation of smaller particles or by condensation of gases on existing particles. It is thought that most of the mass in the accumulation model is formed by physical and chemical processes which convert gases into particles, including trace element fumes from high temperature sources and the transformation products of sulfur oxides, nitrogen oxides, and organic compounds. The large particle fraction of the bimodal distribution is termed the "coarse" mode. Coarse mode particles are generally formed by mechanical processes such as grinding or rubbing, for example, industrial processes, soil, street dust, and rubber tire wear. Chemical composition in this range is dominated by compounds of soil and mineral derived elements such as silicon, iron, and aluminum. There appears to be very little exchange of mass between the fine and coarse particle ranges in the atmosphere because the far greater number and surface area associated with the accumulation mode dominate the condensation and coagulation growth processes. Thus, the fine and coarse particle modes generally have distinctly different origins and chemical compositions.

REFERENCES AND ADDITIONAL INFORMATION - National Assessment of the Urban Particulate Problem, Prepared for EPA by GCA Corporation, Bedford, Massachusetts, EPA 450/3-76-024, July 1976.

QUESTION - What are the major sources of particulate matter in the nation?

ANSWER - A few years ago, the answer to this question would have been a tabulation of the emissions that had been inventoried for major source categories, such as (a) fuel combustion, (b) industrial processes, (c) solid waste disposal, and (d) transportation sources, etc. Today, however, as these sources are being controlled and ambient levels of PM remain high, investigators are finding that other sources of PM also have a significant impact on ambient PM levels. These include the following general categories:

| Source-category | Example |
|---|---|
| Man-made fugitive dust | Dust from paved and unpaved roads |
| Fugitive process emissions | Industrial emissions that are not emitted through a stack |
| Mobile sources | Rubber tire particles, vehicle exhaust |
| Natural sources | Pollen, sea salt, dust storms. |

REFERENCES AND ADDITIONAL INFORMATION - National Assessment of the Urban Particulate Problem, op. cit.

QUESTION - What are the major categories of man-made particulate matter emissions (i.e., traditional sources) in the nation?

ANSWER - On a national basis, the major source categories of man-made particulate matter include the following:

| | Tons/yr | Percent |
|---|---|---|
| Industrial process | 9,265,430 | 50 |
| Fuel combustion | 7,460,856 | 40 |
| Solid Waste Disposal | 884,910 | 5 |
| Transportation<br>(tailpipe and rubber tire particles) | 773,643 | 4 |
| Miscellaneous | 182,909 | 1 |
| Total | 18,556,748 | 100 |

NOTE: It is believed that in general only a limited portion of the fugitive process emissions (i.e., those which escape through windows, doors, and the like, but not through a stack) have been estimated. Man-made fugitive dust sources or secondary particulates are not included in the above table.

REFERENCES AND ADDITIONAL INFORMATION - 1972 National Emissions Report, EPA 450/2-74-012, June 1974, p. 1.

QUESTION - What are "secondary particulates"?

ANSWER - Secondary particulates are the products of chemical reactions occurring in the atmosphere. They can be formed directly from the gas phase or as a result of reactions between gases and already existing particles. The major factors which affect the formation of secondary particulates are sunlight, temperature, pre-existing oxidant, meteorological conditions, and the presence of gases such as sulfur dioxide, ammonia, nitric oxide, water vapor, and hydrocarbons, which enter the atmosphere from both natural and manmade sources. Secondary particulates range in size from molecular clusters with diameters on the order of 0.005 micrometers to particles with diameters as large as several micrometers. Field studies of urban aerosols have shown that most of the mass of secondary particulates is usually found in the particle size range 0.1 to 1.0 micrometers. The concentration of particles in this size range can vary directly with intensity of sunlight and concentration of ozone. Nationwide, about one third of total suspended particulates can be classified as secondary particulates.

The principal factors governing distribution by size are the respective rates of particulate formation and the rates of removal. The smallest particles (0.1 μm), which are created constantly during the daylight hours, coagulate into larger particulates (0.1 to 1 μm). The overall life cycle of secondary particulates is difficult to determine; estimates range from several days to several weeks. In the end, the particles are either removed from the atmosphere by precipitation or dry deposition. During this period, however, they may be transported vast distances from the source of the gaseous precursors.

Found in both urban and rural areas, secondary particulates are in general composed of three chemical classes or categories - sulfates, organics, and nitrates. Annual geometric levels of sulfate and nitrate levels at certain non-urban sites for 1974 are given in Figure 3.

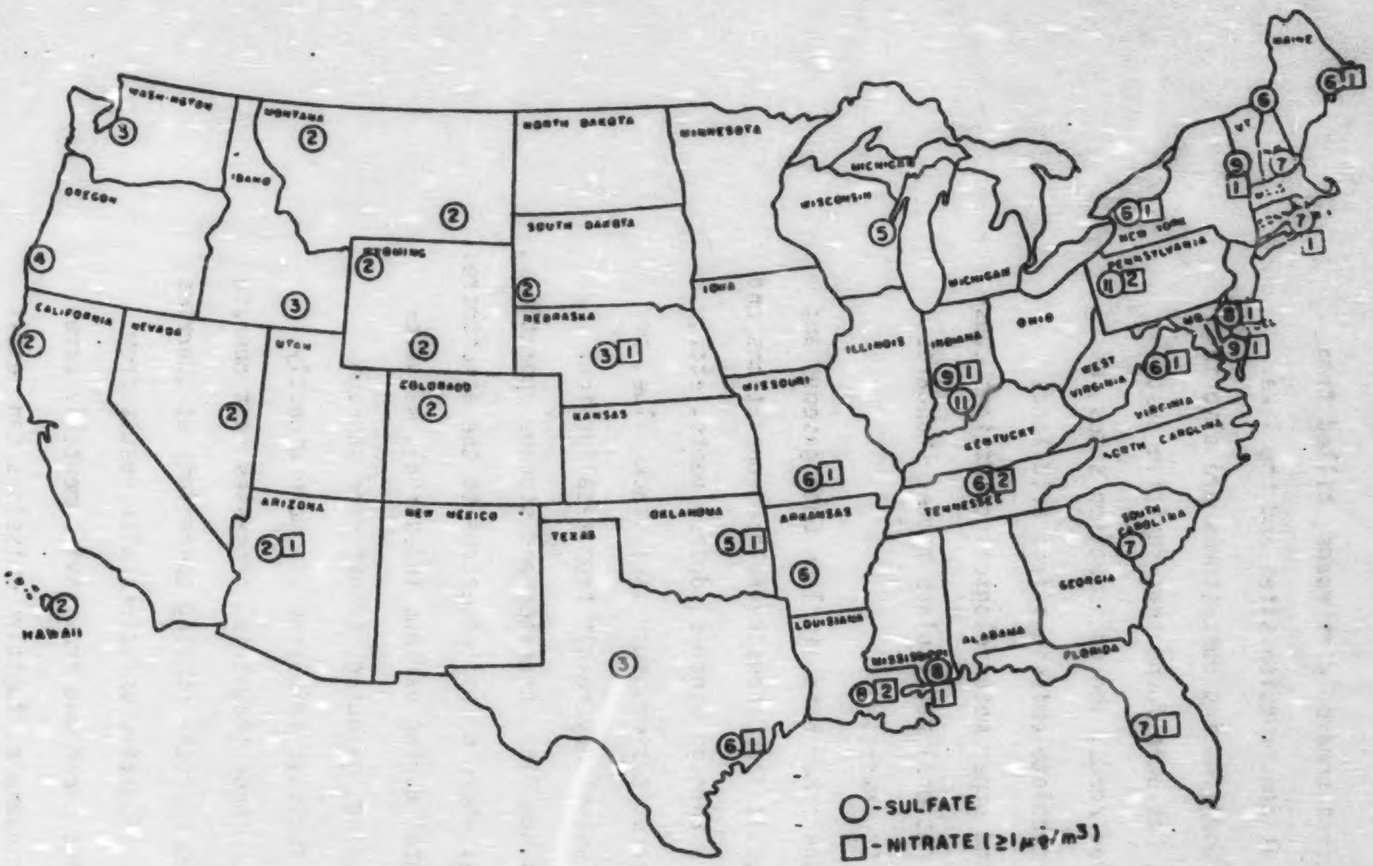
REFERENCES AND ADDITIONAL INFORMATION -

(1) National Assessment of the Urban Particulate Problem, op. cit.

(2) Total Suspended Particulates: Review and Analysis, prepared for EPA by R. Murray Welk, Radian Corporation, EPA 600/2-76-092, April 1976.

QUESTION - More frequently, two sources, fugitive dust and fugitive emissions, are being identified as significant sources of PM. How are the two terms defined, and what are the differences between "fugitive dust" and "fugitive emissions"?

ANSWER - There are no universally accepted definitions to characterize and differentiate between the two separate "fugitive" categories. In fact, some include all fugitive sources in a single definition. Fugitive dust emissions are generally related to natural or man-associated dusts (particulate only) that become airborne due to the forces of wind, man's activity, or both. Fugitive dust emissions may include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NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
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MISSOURI
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MICHIGAN
ILLINOIS
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENNSYLVANIA
NEW YORK
VT
MAINE
HAWAII
○-SULFATE
□-NITRATE (≥1μg/m3)

Figure 3. Annual geometric mean sulfate and nitrate levels at nonurban NASN sites – 1974 (ug/m$^3$)

Source: National Assessment of the Urban Particulate Problem, op.cit., Page 51.

windblown particulate matter from unpaved dirt roads, tilled farm lands, exposed surface areas at construction sites and the like. Natural dusts that become airborne during dust storms are also included as fugitive dusts. It has been found that fugitive dusts from tilled farm lands, unpaved roads, and construction sites, as well as windblown natural particulate emissions from arid lands (desert) during dust storms and other meteorological conditions cause ambient concentrations above national particulate matter standards, particularly in the West and Southwest.

Fugitive emissions, on the other hand, include both gaseous and particulate emissions that result from industry-related operations and which escape to the atmosphere through windows, doors, vents, etc., but not through a primary exhaust system, such as a stack, flue, or control system. Fugitive emissions may result from metallurgical furnace operations, materials handling, transfer and storage operations, and other industrial processes where emissions escape to the atmosphere. Fugitive emissions are generated during various industrial, manufacturing, and/or materials crushing, grinding, transfer or storage operations. In other cases, fugitive emissions are more directly emitted to the atmosphere from those industrial processes that operate out-of-doors, such as coke ovens, rock-crushing operations at quarries, and sand-blasting operations. Fugitive emissions also result from poor maintenance of process equipment and from environmentally careless process operations. For example, fugitive emissions can result from leakage from oven doors at coke ovens because such doors cannot be properly sealed due to excessive warpage.

REFERENCES AND ADDITIONAL INFORMATION -

(1) Lillis, E.J., and Young, D., "EPA Looks at 'Fugitive Emissions'," Journal of Air Pollution Control Association, 25: 1015-1018, October 1975.

(2) National Assessment of the Urban Particulate Problem, op. cit.

QUESTION - What are the most significant man-made fugitive dust sources?

ANSWER - Included in this category are reentrainment of road dust, fugitive dust emissions from construction and demolition operations, dust from unpaved areas and dust generated by other urban activities such as unpaved parking lots and bare unvegetated lots. In a number of cases, particulates from these sources have prevented urban areas from attaining ambient standards and, unless controlled, they will continue to do so. Given the current downward trend in emissions from traditional sources, particulate matter from fugitive dust sources will proportionally pose a greater problem for attainment and maintenance of the ambient standards.

REFERENCES AND ADDITIONAL INFORMATION - National Assessment of the Urban Particulate Problem, op. cit.

QUESTION - What emission factors are available for fugitive dust sources and what work is underway to develop additional factors?

ANSWER - Section 11.2 of Compilation of Air Pollution Emission Factors (AP-42), February 1976, contains emission factors for heavy construction operations sites, aggregate storage piles, agricultural tilling, and unpaved dirt and gravel roads. The emission factors for unpaved roads are being refined by current studies for which the field work is now beginning.

Additionally, unpaved roads are another fugitive dust source for which emission factors are being developed. The field testing for these emission factors has been completed, and the factors should be finalized within several months and published within AP-42. Dust from paved roads, sometimes called "re-entrained" particles, is a major portion of the PM load in many areas.

Other attempts have been made to determine emission factors from various fugitive dust sources. A 1974 report provides estimates for particulate matter emissions from cattle feedlots, tailings piles, and windblown dust from farm lands. For farm lands, the USDA wind erosion equation was used to estimate emissions. Individual calculations for each major crop were performed since ground cover conditions, and hence soil erosion potential, vary from crop to crop.

The caution stated earlier in Section II should be reiterated here. Emission data on PM sources require considerable detail, especially concerning particle size and density information, before use in diffusion models. PM sources cannot be arbitrarily input to conventional models.

### REFERENCES AND ADDITIONAL INFORMATION -

(1) Investigation of Fugitive Dust Sources, Volume I - Sources, Emissions, and Control, EPA 450/3-74-036(a), June 1974.

(2) Compilation of Air Pollutant Emission Factors, Second Edition, with Supplements 1-5, February, 1976; EPA Publication AP-42.

(3) Development of Emission Factors for Fugitive Dust Sources, EPA 450/3-74-037, June 1974.

QUESTION - What silt content should be considered in calculating the emissions from unpaved roads?

ANSWER - The most comprehensive studies show that roadway dust emissions are directly proportional to the silt content of the loose soil on the road surface and to vehicle speed. "Silt content," defined as the percentage (by weight) of soil particles less than 75$\mu$m in diameter, is an essential part of the development of accurate emission factors for unpaved roads.

As published in Compilation of Air Pollutant Emission Factors (AP-42, Part A), the quantity of fugitive dust emissions from an unpaved road, per vehicle-mile of travel, may be estimated (within ± 20 percent) using the following empirical expression:

$$E = \left(0.81\, s\right)\left(\frac{S}{30}\right)\left(\frac{365 - w}{365}\right)$$

where: $E$ = Emission factor, pounds per vehicle-mile

$s$ = Silt content of road surface material, percent

$S$ = Average vehicle speed, miles per hour

$w$ = Mean annual number of days with 0.01 in. (0.254 mm) or more of rainfall

The equation is valid for vehicle speeds in the range of 30-50 mi/hr (48-80 km/hr).

On the average, dust emissions from unpaved roads, as given by equation 1, have the following particle size characteristics:

| Particle size | Weight percent |
|---|---|
| $< 30\ \mu m$ | 60 |
| $> 30\ \mu m$ | 40 |

The silt content of gravel roads averages about 12 percent, and the dirt road may be approximated by the silt content of the parent soil in the area. However, a recent study in the Phoenix, Arizona, area demonstrated that the silt content of soil on a roadway may vary as much as 20 to 60 percent from the average silt content of the surrounding soil. It is, therefore recommended that field test data of the silt content of the roadway be used in conjunction with the above AP-42 emission factor formula.

REFERENCES AND ADDITIONAL INFORMATION -

(1) Compilation of Air Pollutant Emission Factors (AP-42), op.cit.

(2) An Implementation Plan for Suspended Particulate Matter in the Phoenix Area, TRW Inc., Draft Report, Nov. 1976.

(3) Appendix F and Problem 3-3 in Air Quality Analysis Workshop Volume I - Manual, op. cit.

QUESTION - Which existing stationary sources of PM are required to continuously monitor opacity?

ANSWER - On October 6, 1975, EPA promulgated regulations (40 FR 46240) requiring States to revise their SIPs to include requirements for the continuous monitoring of emissions from certain categories of existing stationary sources affected by emission limitation of an approved SIP. Appendix P of 40 CFR 51 lists the following source categories as being covered by the regulation for monitoring of opacity:

1. Coal-fired, and some oil-fired steam generators in excess of 250 million BTU/hr heat input, with certain exceptions for age and use of each boiler.

2. Fluid bed catalytic cracking unit catalyst regenerators (at petroleum refineries) of greater than 20,000 barrels per day fresh feed capacity.

Revisions to SIPs to require continuous emission monitoring were scheduled to be submitted by the States to Regional Offices by October 6, 1976. The State regulations may allow 18 months after EPA approval of the State submitted SIP revisions for sources to procure, install, and begin operating the monitoring instruments. Quarterly reports of (1) emissions in excess of SIP emission limitations, and (2) the monitoring system downtime must be submitted by the sources to the States.

REFERENCES AND ADDITIONAL INFORMATION - "Emission Monitoring of Stationary Sources," (40 FR 46240), Oct. 6, 1975.

QUESTION - Which new stationary sources of particulate matter are required to monitor opacity?

ANSWER - On October 6, 1975, EPA promulgated regulations (40 FR 46250) under 40 CFR, Part 60, New Source Performance Standards, which require continuous monitoring of particulate emissions from certain new sources, which are specified by category. The primary source categories are fossil fuel-fired steam generators and fluid bed catalytic cracking unit catalyst regenerators. The regulation requires that all new fluid bed catalytic cracking unit catalyst regenerators apply continuous monitoring for opacity and that all new fossil fuel-fired steam generators of greater than 250 million BTU per hour heat input (except those where only gaseous fuel is burned) apply continuous monitoring for opacity.

In addition, two other source categories are regulated by continuous monitoring under New Source Performance Standards. The September 23, 1975, Federal Register contains regulations (40 CFR 60.272) for electric arc furnaces in the steel industry. The regulations require continuous monitoring of the opacity of emissions discharged into the atmosphere from the control device(s) of "any furnace that produces molten steel and heats the charge materials with electric arcs from carbon electrodes."

The Federal Register contains regulations which require continuous monitoring of the opacity of emissions discharged into the atmosphere from the control device(s) of ferroalloy production facilities, including "electric submerged arc furnaces which produce silicon metal, ferrosilicon, calcium silicon, silicomanganese zirconium, ferrochrome silicon, silvery iron, high-carbon ferrochrome, charge chrome standard ferromanganese, silicomanganese, ferromanganese silicon, or calcium carbide" and the "dust handling equipment" associated with these facilities.

REFERENCES AND ADDITIONAL INFORMATION -

(1) "Emission Monitoring Requirements and Revisions to Performance Testing Methods", (40 FR 46250), Part 60, Oct. 6, 1975.

(2) (40 FR 43850), Sept. 23, 1975 (40 CFR 60.273).

(3) (41 FR 18502), May 4, 1976 (40 CFR 60.264).

# IV

## QUESTIONS CONCERNING AIR QUALITY STANDARDS AND MEASUREMENT

QUESTION - What are the National Ambient Air Quality Standards (NAAQS) for particulate matter?

ANSWER - The primary NAAQSs are 75 $\mu g/m^3$ (annual geometric mean) and 260 $\mu g/m^3$ (maximum 24-hour average concentration not to be exceeded more than once per year). The secondary NAAQSs are 60 $\mu g/m^3$ (annual geometric mean) and 150 $\mu g/m^3$ (maximum 24-hour concentration, not to be exceeded more than once per year). Although referred to as a standard, the 60 $\mu g/m^3$ annual geometric mean is "a guide" (i.e., not a standard). It may be used in developing and assessing implementation plans to achieve the secondary 24-hour standard.

REFERENCES AND ADDITIONAL INFORMATION -

(1) 40 CFR Part 50.7, National Primary and Secondary Standards for Particulate Matter, promulgated April 30, 1971.

(2) Air Quality Criteria for Particulate Matter, AP-49, January 1969.

QUESTION - Are the current standards for particulate matter being reviewed?

ANSWER - Yes. Plans were made at a joint ORD/OAQPS meeting on August 6, 1976, to revise and reissue the air quality criteria documents. The original criteria document for particulate matter was issued in 1969 and has remained unchanged. Revision of all criteria documents has been recommended by the National Air Quality Criteria Advisory Committee of the Science Advisory Board.

In addition, the Clean Air Act as amended in 1977 requires that "not later than January 1, 1980 and at five-year intervals thereafter a review of the national primary and secondary ambient air quality standards shall be completed..." Furthermore, revision of the documents allows the Agency to publish the latest technical information supporting the National Ambient Air Quality Standards and the national regulatory program.

The criteria document for particulate matter is scheduled for revision by August 1979.

REFERENCES AND ADDITIONAL INFORMATION -

Steigerwald, B.J., and Barth, D., Memorandum to Roger Strelow and Wilson Talley, "Revision of Air Quality Criteria Documents," August 26, 1976.

QUESTION - When would the secondary annual standard of 60 $\mu g/m^3$, annual geometric mean, be used as a guide to determine if a control strategy will result in attainment of the 24-hour standard of 150 $\mu g/m^3$ not to be exceeded more than once per year?

ANSWER - To determine the average concentration for a period of 24-hours, three options are available. The preferred option is to use a model to estimate concentrations hour-by-hour for the period under consideration and average the values of all the hours calculated. This option is discussed in detail in the Guideline on Air Quality Models and Associated Data Bases, (EPA, Monitoring and Data Analysis Division, Draft May 1977). If this is not possible, the second option is to convert a concentration for one averaging time (annual) to a concentration for a shorter time by empirical techniques for urban multi-source areas or by empirical techniques and data on the peak-to-mean ratio for point sources.

The second option may not be possible if certain statistical information such as the standard geometric deviation (sgd) of particulate concentrations is not available. Also, such sgd information as is available may be unreliable because of variability. Finally, the option of using the secondary annual guide would apply where diffusion modeling cannot be performed because of lack of input parameters. For this case, it would be necessary to use a proportional model such as rollback. In the last two situations, it is reasonable under the regulations in Part 51 to develop a control strategy which demonstrates attainment of the secondary standards by using the 60 $\mu g/m^3$ annual guide as a planning tool rather than the secondary 24-hour standard of 150 $\mu g/m^3$.

QUESTION - Is any consideration being given to the promulgation of a national standard that considers particle size or chemical composition?

ANSWER - Yes. When the current PM standards were promulgated in 1971, it was generally recognized that other national standards for specific fractions or components of PM might be necessary. Studies have indicated that fine and secondary components of PM have serious health effects associated with them. EPA is still studying the need for specific air quality standards for these components. Recent evidence suggests an approach which places greater emphasis on the control of selected categories of particulate matter such as sulfates, nitrates, etc., with continued reliance on the current PM standard for overall control of particulates rather than developing a fine particulate standard.

In a recent court action, NRDC v. Train (9 ERC 1425, 2nd Cir. 1976), EPA was directed to develop an air quality standard for lead. Additional air quality standards with regard to other fractions may be developed in the future, depending on research and/or court action.

It is worthwhile to note that it is not anticipated that the current PM standard will be rescinded or replaced in the next several years. It may be supplemented but it will not be withdrawn. Attainment of current PM standards should be the goal everywhere.

REFERENCES AND ADDITIONAL INFORMATION -

(1) Steigerwald, B.J., Memorandum to Rober Strelow, "Fine Particulate Control Strategy," July 2, 1975.

(2) Padgett, J., and Bachman, J., "Regulatory and Technical Control Strategies for Fine Particles," given at June 1976 APCA Meeting, Portland, Oregon, APCA Paper No. 76-30.07.

QUESTION - What ambient measurement techniques are acceptable for monitoring PM?

ANSWER - The hi-volume method is the Federal Reference Method (FRM) for total suspended particulates. Since the air quality standard is defined by the method, the hi-volume sampler is the only acceptable method. No procedures for determining equivalency of alternative methods have been developed, so all other methods are to be considered unacceptable for determining attainment or status with respect to NAAQS.

REFERENCES AND ADDITIONAL INFORMATION -

40 CFR Part 50, Appendix B, Reference Method for the Determination of Suspended Particulates in the Atmosphere (High Volume Method).

QUESTION - What is meant by the term "background concentration" and what are typical values taken to represent "background"?

ANSWER - Background concentrations are defined in 40 CFR 51.13 as follows:

> For purposes of developing a control strategy, background concentration shall be taken into consideration with respect to particulate matter. As used in this subpart, 'background concentration' is that portion of the measured ambient levels of particulate matter that cannot be reduced by controlling emissions from manmade sources; 'background concentration' shall be determined by reference to measured ambient levels of particulate matter in nonurban areas.

Unfortunately, this definition reflects to some extent the prevalent variation in usage of the word "background," and hence contradictory usage of the term continues. Under the first part of the last sentence, in which background is defined as the uncontrollable portion of PM, EPA regulations provide for rollback calculations to ascertain the degree of emission control necessary for the attainment of the air quality standards. The rollback formula:

$$\text{reduction required} = \frac{\text{ambient} - \text{standard}}{\text{ambient} - \text{background}}$$

tacitly assumes that the background level is a lower limit below which the ambient concentration cannot be reduced. On the other hand, in air quality modeling efforts, the background is frequently defined as the difference between the measured concentrations and the calculated concentrations which includes into background any source not included in the inventory used. In still other circumstances, an agency may choose to regard as "background" any PM coming across the boundary into their jurisdiction, regardless of whether that jurisdiction extends appropriately into nonurban areas.

Contradiction in the usage of the term background also arises from the latter part of the above citation referring to the actual measurement of background. Following that concept, the background levels most often used in air quality reflect measurements of the ambient air quality in some remote rural area; this may possibly be within the county, AQCR, or state, depending upon the jurisdiction of the planning agency; or may be very far away. Where possible, these measurements are made upwind of the prevailing flow of air so as not to sample the particulate contribution of the area. However, what these remote monitors are actually measuring is not necessarily an uncontrollable or nonmanmade level of PM. Rather, these measurements simply reflect the particulate concentrations coming into the urban area, including not only the natural, uncontrollable particulates but also man's contribution to the nonurban particulate levels; these latter include emissions in rural areas, particles transported from distant urban areas, and secondary particulates. They can be broken down as follows:

1. Natural particulate - PM contributed solely by natural processes and thus uncontrollable; includes a global contribution, which includes both primary and secondary particulates, and a continental contribution, primarily from wind erosion of soil.

2. Transported particulate - PM levels that arise due to emissions from man's activities in "upwind" urban and industrial areas; include both primary and secondary particulates transported from one area to another.

3. Local particulate - PM measured at nonurban monitors that is contributed by emissions in rural areas and affected by the placement of the monitor.

Thus, the term "background concentration" can have a variety of meanings. The control strategy developer and/or reviewer should be aware of the possible variations and act accordingly.

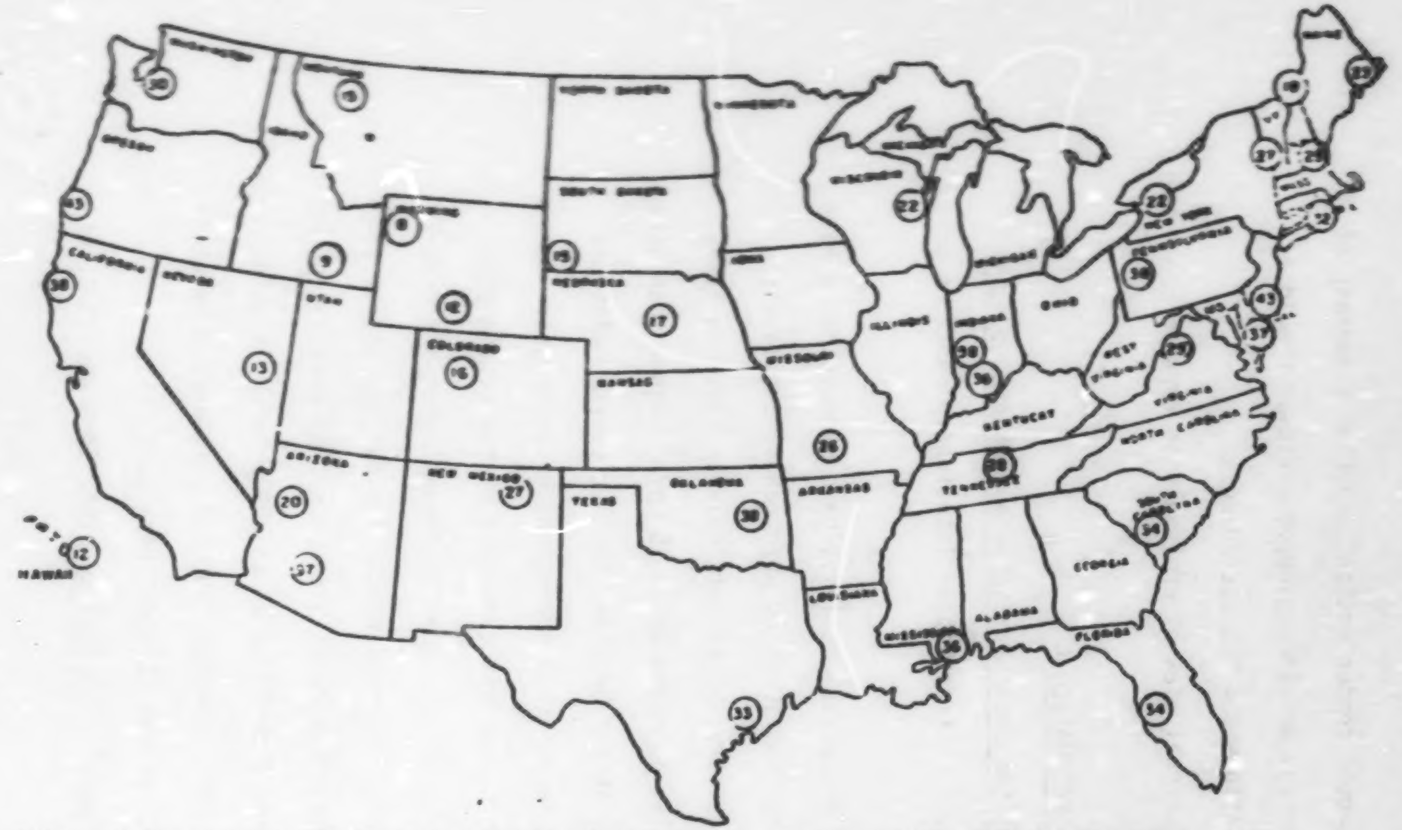
Figure 4 provides a national view of PM levels at certain non-urban sites for 1970 through 1973.

REFERENCES AND ADDITIONAL INFORMATION -

National Assessment of the Urban Particulate Problem, op. cit.

QUESTION - What is the impact of traditional (stationary) sources on air quality?

ANSWER - Cities with heavy industrial activity have been found to have citywide PM levels averaging from 10 to 60 $\mu g/m^3$ above the levels of cities with little or no industry; sites particularly close to heavy industrial activity typically averaged up to 25 $\mu g/m^3$ higher than other industrial sites. Further, it can be shown that as source emissions are controlled, ambient PM levels show corresponding decreases. For example, in Buffalo, New York, the effectiveness of the stationary source control program can be seen in the improvement that has occured in ambient air quality levels. Average annual air quality levels at eight sites located throughout the Buffalo area in 1969 were 130 $\mu g/m^3$, with individual sites ranging from 80 $\mu g/m^3$ to 229 $\mu g/m^3$. In 1974, after control efforts were well underway (but not complete), the area-wide average for the same sites was 82 $\mu g/m^3$ with an individual site range from 58 $\mu g/m^3$ to 121 $\mu g/m^3$. (Annual Reports, 1973 and 1974, Air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NORTH DAKOTA
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OKLAHOMA
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WISCONSIN
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TENNESSEE
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MISSISSIPPI
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ALABAMA
GEORGIA
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SOUTH CAROLINA
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VIRGINIA
WEST VIRGINIA
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Source: National Assessment of the Urban Particulate Problem, Prepared for EPA by GCA Corp., Bedford Mass., EPA 450/3-76-024, July 1976, p. 49.

Figure 4 Composite annual geometric mean TSP levels at nonurban NASN sites from 1970 through 1973 (μg/m$^3$)

Pollution Control Division, Department of Health, Erie County, New York.) These data indicate the significant impact of stationary source emissions on air quality and the necessity of minimizing stationary source emissions as an important part of any PM control strategy.

REFERENCES AND ADDITIONAL INFORMATION -

(1) National Assessment of the Urban Particulate Problem, op. cit.

QUESTION - What is the impact of the most significant man-made fugitive dust sources on air quality?

ANSWER - The air quality impact of fugitive dust sources varies, depending upon the specific fugitive dust source. Estimates have been made for some fugitive dust categories. These include:

Reentrained dust - In an urban area, particulate matter accumulates on the various city surfaces due to various mechanisms, including atmospheric fallout. Especially heavy loads on streets can result from dirt and mud carryout from unpaved parking lots and roads, spillage from trucks, and sand and salt applied for snow control. This material can then become entrained and at least temporarily suspended in the ambient air due to (a) wind erosion, or (b) man's activities disturbing the surface. The annual average impact on residential monitors is estimated at 10 to 15 μg/$m^3$ and 15 to 20 μg/$m^3$ at commercial and industrial sites, respectively, but varies widely with traffic and monitor placement. The composition of this component is mostly mineral matter.

Construction activity - Several sites, often center city commercial sites, are hindered in meeting national standards by dust entrained from construction sites of various types, including urban renewal, small building construction, and highway and subway construction. Particulate matter emissions are generated by a wide variety of operations over the duration of the construction, including land clearing, blasting, ground excavation, and on-site traffic, as well as the construction of the facility itself. Annual average impacts of 10 to 20 μg/$m^3$ are common only if the construction is close to the monitoring site. Cities with typical levels of construction were found to have citywide annual average impacts on the order of 1 to 3 μg/$m^3$. Construction will generally elevate concentrations downwind from the site for distances of up to 1/2 to 1 mile; the amount of increase is related to the level of activity, type of activity, distance from the activity, and control measures employed.

REFERENCES AND ADDITIONAL INFORMATION -

National Assessment of the Urban Particulate Problem, op. cit.

QUESTION - What is the impact of mobile sources on air quality?

ANSWER - Particulate emissions from mobile sources have generally been only lightly considered in past control strategies. Recent studies have indicated that particulate emissions from such sources, specifically rubber tire particles and automotive exhaust can be significant. For example:

Rubber Tire Particles - This source varies with neighborhoods. Typical annual average impacts are 3 $\mu g/m^3$ at residential sites and 5 $\mu g/m^3$ at commercial and industrial sites. Sites located particularly near heavy traffic averaged twice the levels at other sites.

Automotive Exhaust - This source also varies somewhat with neighborhoods, with typical annual average concentrations of 3 $\mu g/m^3$ in residential and 4 to 5 $\mu g/m^3$ in commercial and industrial areas. This estimate is for the primary particulate only and is generally about 15 to 25 percent lead. The value could be higher if measured close to heavy traffic.

REFERENCES AND ADDITIONAL INFORMATION -

(1) National Assessment of the Urban Particulate Problem, op.cit.

(2) Lillis, E.J., and Dunbar, D.R., "Impact of Automobile Particle Exhaust Emissions on Air Quality", OAQPS, EPA, November 13, 1975, unpublished paper.

QUESTION - How much ambient PM data are needed to indicate that a SIP needs to be revised, or to serve as the basis of a control strategy?

ANSWER - There is no absolute answer to this question. Measured air quality data are considered the best evidence to indicate that a SIP is inadequate to provide for attainment of national standards and to serve as the indication of the degree of control needed to provide for attainment and maintenance of standards. However, lack of such data do not preclude determination of SIP adequacy or control strategy development. For PM, various simulation models exist which provide a mathematical technique for estimating air quality concentrations in most areas. While ambient PM concentrations should be available in most areas where national standards may potentially be violated, models can be used to supplement existing measured data or replace measured data when it is not available.

REFERENCES AND ADDITIONAL INFORMATION -

Air Quality Analysis Workshop Volume I - Manual, Prepared for EPA by Argonne National Laboratory, Argonne, Illinois, EPA 450/3-75-080a, Nov. 1975, Ch. 7.

QUESTION Historically, what type of air quality trends have been observed for PM?

ANSWER - On a national basis, general improvement has been observed in annual PM levels since 1970.

The trends have been observed from a data base of approximately 1800 monitoring sites which are located throughout the county and have sufficient historical data for use in determining trends.

The general improvement in PM ambient air quality is continuing. Recent trends since 1971 indicate a general improvement of 4 percent per year. There have been some geographical differences with Northeast and Great Lakes areas improving at even higher rates. Levels in some of the Western states have been fairly stable, probably due to fugitive (wind blown) dust and to some extent due to secondary particulates caused by photochemical reactions in areas such as Los Angeles.

This progress with respect to PM means that nationally 33 percent fewer people were exposed in 1974 to annual mean levels in excess of the primary standard than were exposed in 1970. Further improvements in PM air quality levels are anticipated, but the present rate of progress may not be sustained since fewer traditional sources remain to be controlled and since fugitive dust, re-entrained urban particulates, and secondary particulates are more difficult to control.

Even though improvements have been made, a significant PM ambient problem still remains. The most recent data (1975) show that approximately 50 percent of the state and local monitoring stations have annual averages in excess of the secondary annual PM air quality standard.

REFERENCES AND ADDITIONAL INFORMATION -

(1) National Air Quality and Emission Trends Report, 1975, EPA 450/1-76-002, Nov. 1976.

(2) Monitoring and Air Quality Trends Report, 1974, EPA 450/1-76-001, Feb. 1976.

QUESTION - What guidance is available with regard to locating and operating PM monitors in the field to provide representative samples?

ANSWER - The proper siting of monitoring instruments and the proper design of a monitoring network is crucial to collecting representative samples. The subjects are addressed in detail in Guidance for Air Quality Monitoring Network Design and Instrument Siting (Revised), OAQPS No. 1.2-012, Sept. 1975. This document is comprehensive in nature and describes various monitoring objectives, based on the intended uses for the air quality data. The document contains guidance for placement of the hi-vol monitor between 2 and 15 meters above ground level, with at least 2 meters horizontal clearance from supporting structures or other restrictions to air flow.

It is recognized that these guidelines have generally allowed flexibility to State and local agencies in locating ambient PM monitors. Thus, monitoring networks across the nation are generally termed "non-uniform."

More specific guidance on siting of monitors and design of monitoring networks has been developed. The Agency's Standing Air Monitoring Work Group has drafted Air Monitoring Strategy for State Implementation Plans, EPA Report No. 450/2-77-010, June 1977. The purpose of this guidance is to provide more uniform and accurate monitoring patterns to assure that basic data needs of air pollution control programs are met and to ensure uniformity in the data collected throughout the nation. The results of this report suggest an increase in the monitors included in the Quality Assurance Monitor Program from the present level of 6 percent to approximately 15 percent. It also calls for revision to 40 CFR 51 to reflect the diminished need for large quantities of data which will not be needed in the control programs for ambient air quality maintenance. These and other recommended revisions will be incorporated in a revised version of the Siting Guideline OAQPS No. 1.2-012, now in preparation.

QUESTION - What is EPA policy on the use of correction factors for adjusting TSP hi-vol readings to allow for accumulation of particulate matter during the static mode?

ANSWER - EPA has examined this issue and does not feel that use of a correction factor is appropriate at this time because:

(a) Studies conducted to date may not be reliable. All the studies were conducted over a short-time period (three months or less) and none had any discussion or documentation of quality assurance procedures used.

(b) The Environmental Monitoring and Support Laboratory Research Triangle Park (EMSL-RTP) has embarked on a one year particulate sampling characterization study. This study will take a comprehensive look at parameters affecting hi-vol measurements.

Once the EMSL-RTP study is completed, this issue will be re-examined. In the interim, if a control agency feels that the static mode contribution is significant they should be encouraged to service the hi-vol as soon as possible before and after the sampling day. EPA recognizes that additional travel will be necessary. However, only those sites which are essential for particulate matter attainment/maintenance decisions would need to be serviced immediately before and after the sampling day. If the hi-vols were located with continuous monitors, daily trips (or visits more frequent than once every six days) to the site may already be agency practice and thus little additional travel would be necessary.

REFERENCES AND ADDITIONAL INFORMATION -

Barber, Walter C., Memorandum to Directors, Air and Hazardous Material Divisions, Regions I-X, "Correction Factor for Static Mode Contribution to TSP Air Quality," May 17, 1977.

# V

# QUESTIONS CONCERNING DATA AND FUND UTILIZATION

QUESTION - To what extent does growth information employed in plan development have to be internally consistent?

ANSWER - Growth information employed in plan development where 40 CFR 51 Subpart D applies (Air Quality Maintenance Regulations) must be in accordance with applicable AQM guidelines unless alternative techniques are approved by the Administrator. Emissions must normally be projected for the following categories:

Industrial process activity.
Fuel consumption.
Transportation activity.
Electricity demand.
Solid waste generation.
Miscellaneous emission-producing activity.

These may be converted to emissions using emission factors. In addition, the temporal and spatial distribution of these variables (e.g., when new plants will come on line and where they will be located) is important to the air quality analysis. In most situations, projections of these parameters are not available or are available only on a cruder scale than needed for an adequate air quality analysis, especially in attainment/maintenance problem areas. Reliance must then be placed on surrogate variables such as population, employment, land use, earnings, and others that are projected with reasonable accuracy and precision and that can then be transformed into growth factors for the desired variables. These surrogate variables are used to develop predicted growth patterns for the future.

One of the problems that the lead agency has in developing growth factors is the reconciliation of the various planning outputs. In order to use information from the various groups, it will be necessary to insure that they are based on compatible assumptions and data bases. The need for a coordinated effort on the part of the involved organizations is reemphasized by this need for a unified projection plan upon which to base the analysis. The question of how many alternative growth patterns should be evaluated as part of the air quality analysis is answered by the available resources.

However, it is difficult to get consistent projections because of different time frames and data bases used by the various planning groups. Transportation planning groups base their projections on various transportation scenarios (e.g., highway development emphasis, transit emphasis, etc.). Comprehensive planning groups may use land-use development scenarios as the driving mechanism. These differences can result in wide discrepancies in the projection of regional development.

Long-range planning has been carried out for many years in a number of areas. The information required for the air quality analysis should build on the experience and background of the planning groups that have been involved in these activities. There are four federally-funded planning programs that should be able to provide some framework for the projections. They are:

HUD 701 planning,
FHWA 3-C planning,
EPA 208 planning,
CZM planning.

The OBERS growth projections are also federally funded, and a good source of overall growth data.

There are, of course, numerous local and regional studies that can be used to supplement this information. A detailed discussion of planning programs listed above can be found in Air Quality Analysis Workshop Volume I - Manual, op. cit., page 63.

The agency should evaluate all these projections, choose the most accurate and reliable, and use these variables as a basis for all projections. Also, growth information employed in development of SIP revisions involving control strategies should be consistent with that employed in the development of a Water Quality Management (WQM) program under Section 208 of the Water Pollution Control Act Amendments of 1972. This kind of consistency is usually not a problem if one reliable source of growth information is used.

REFERENCES AND ADDITIONAL INFORMATION -

(1) Guidelines for Air Quality Maintenance Planning and Analysis, Vol. 3: Control Strategies, EPA 450/4-74-003, July 1974, (OAQPS No. 1.2-022).

(2) Guidelines for Air Quality Maintenance Planning and Analysis, Vol. 7: Projecting County Emissions (Second Edition), EPA 450/4-74-008, January 1975 (OAQPS No. 1.2-026).

(3) Air Quality Analysis Workshop Volume I - Manual, op.cit., Chapter 4.

QUESTION - How could one utilize 208 planning funds for developing air quality projections and subsequent plan development?

ANSWER - The use of 208 funds can be used to project air quality resulting from the implementation of Water Quality Management (WQM) programs. Some specific activities which can be funded by 208 program funds include: (1) developing common data bases for WQM and Air Quality Management (AQM) programs, (2) development of common public participation programs, (3) development of control strategies or measures that will achieve the objective of both AQM and WQM plans, and (4) development of statutes, regulations, or administrative procedures relating air, water and land use. More information on specific uses, and EPA policy relating to the interrelationship of AQM and WQM programs, can be found in the memo; "Relationship Between Air Quality Planning and the State and Areawide Water Quality Management Program." This is available in the OAQPS Guideline Series, OAQPS No. 3.0-022, November 15, 1976.

# VI

## QUESTIONS CONCERNING MODELING

QUESTION - What mathematical diffusion models are recommended for estimating ambient PM concentrations?

ANSWER - Various technical guidance has been prepared on available models, one of which is Volume 12 of EPA's Guidelines for Air Quality Maintenance Planning and Analysis: Applying Atmospheric Simulation Models to Air Quality Maintenance Areas. (EPA 450/4-74-013, September 1974, OAQPS 1.2-031). Although the title specifically identifies "maintenance" areas rather than "attainment" areas, this document can be useful in selecting dispersion models for other strategy situations except fugitive PM problems. The document contains a good summary of the availability, advantages and disadvantages of individual simulation models.

The Guideline on Air Quality Models and Associated Data Bases (Draft) was circulated by OAQPS to all Regional Offices for comment in February 1977. Late that month EPA held a Specialist Conference on the guideline and a report is in preparation. Following several public comment workshops and at least one comprehensive conference, the final version of the guideline is expected to be issued in early 1978. The guideline will update the Volume 12 information.

A brief discussion of the more important models listed in Volume 12 and the guideline above follows.

Models Available for Particulate Matter (Annual Average) - The Air Quality Display Model (AQDM) of the Climatological Dispersion Model (CDM) is used to evaluate control strategies for both point sources and multi-source complexes. However, the Single Source (CRSTER) Model is perferred for analysis of point sources when they are analyzed separately. With the approval of the Regional Administrator, other models may be used in the following circumstances:

(1) If a more accurate or more detailed model is available for simulation, especially if the region has major meteorological or topographic complexities, that model may be used.

(2) If the meteorological or topographic complexities of the region are such that the use of any available air quality model is precluded, then the model used for strategy evaluation may be limited to a Rollback Model.

Models Available for Particulate Matter (24-Hour Averages). - Point source models which consider critical dispersion conditions characterized by looping, fumigation, high-wind coning, limited mixing, etc., are used to evaluate control strategies for individual point sources. Point source models other than those referenced shall be used only with approval of the Regional Administrator.

RAM is recommended for use in evaluating control strategies for multi-source complexes. If the resources required to operate RAM are not available, then AQDM or CDM may be used. AQDM or CDM must be used with procedures for the statistical conversion of averaging times as discussed by Larsen to convert annual average concentration estimates to 24-hour average concentrations; other similar statistical techniques for making this conversion may also be used. Only with the approval of the Regional Administrator may other models be used in the following circumstances:

(1) If a more detailed or more suitable model is available, especially in a Region which has major meteorological or topographic complexities, that model may be used.

(2) If the meteorological or topographic complexities of the Region are such that the use of any available air quality model is precluded, then the model used for control strategy evaluation may be limited to a Rollback Model.

(3) If a more accurate or more detailed model, e.g., the Valley Model, is available for simulation in a Region with major meteorological or topographic complexities and the Regional Administrator judges it appropriate, the model may be used.

REFERENCES AND ADDITIONAL INFORMATION -

(1) 40 CFR Part 51, Appendix A, Air Quality Estimation.

(2) Air Quality Analysis Workshop, Vol. I - Manual, Chapter 6, "Model Procedures," EPA 450/3-75-80a.

(3) Strelow, R., Memorandum to various RO Division Directors, Regions I-X, "Use of Dispersion Model Estimates to Identify Potential Air Quality Standard Violations," November 1, 1976.

(4) Environmental Protection Agency. "User's Network for Applied Modeling of Air Pollution (UNAMAP)." (Computer Programs on Tape for Point Source Models, HIWAY, Climatological Dispersion Model and APRAC-1A) (NTIS PB 229771), National Technical Information Service, Springfield, Virginia, 1974.

(5) Carpenter, S.B., et al. "Principle Plume Dispersion Models: TVA Power Plants." J. Air Poll. Control Assn., Vol. 22, No. 8, pp. 491-495, 1971.

(6) Environmental Protection Agency. "Reviewing New Stationary Sources." Guidelines for Air Quality Maintenance Planning and Analysis, Volume 10; OAQPS No. 1.2-029, (NTIS PB 237535/AS), Environmental Protection Agency, Research Triangle Park, North Carolina, September 1974.

(7) Novak, J.H. and D.B. Turner. "An Efficient Gaussian-Plume Multiple-Source Air Quality Algorithm." J. Air Poll. Control Assn., Vol. 26, No. 6, pp. 570-575, 1976.

(8) Turner, D.B. and J.H. Novak, Memorandum to EPA Dispersion Model Users, "Provisional Availability of RAM," August 11, 1976.

(9) Pooler, F. "Potential Dispersion of Plumes from Large Power Plants." PHS Publication No. 99-AP-16, (NTIS PB 168790). Superintendent of Documents, Government Printing Office, Washington, D.C., 1965.

(10) Smith, M.E., Ed. "Recommended Guide for the Prediction of the Dispersion of Airborne Effluents." The American Society of Mechanical Engineers, New York, N.Y., 1968.

(11) Turner, D.B. "Workbook of Atmospheric Dispersion Estimates." PHS Publication No. 999-AP-26 (NTIS PB 919482), Office of Technical Information and Publications, Environmental Protection Agency, Research Triangle Park, N.C., 1970 (Rev.)

(12) Larsen, R.I. "A Mathematical Model for Relating Air Quality Measurements to Air Quality Standards." Office of Air Programs Publication No. AP-89 (NTIS PB 205277), Office of Technical Information and Publications, Environmental Protection Agency, Research Triangle Park, N.C., November 1971.

QUESTION - What EPA assistance is available for using the models in Volume 12 and the Guideline Air Quality Models?

ANSWER - The National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161 (telephone 703-557-4650) stocks the following user's guides.

| Model | Access Number |
|---|---|
| AQDM | PB 189-194 |
| CDM | PB 227-346-AS |
| PT (UNAMAP) Models | PB 229-771 |

Copies can be obtained directly from NTIS. A computer card deck for the AQDM program is available from EPA Office of Administration, Technical Information Center, Research Triangle Park, N.C. 27711 (MD 35). More specific assistance is available through EPA Regional Offices.

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QUESTION - What techniques are available for fugitive dust modeling?

ANSWER - The models currently available do not adequately consider typical fugitive dust sources or the number of mechanisms involved with fugitive dust. Typical Gaussian-type dispersion models do not properly consider the physical characteristics or the emissions of unpaved roads, storage piles, resuspended street dust or other fugitive dust sources. Nor do they consider gravitational settling or dry and wet deposition of particulate matter, since all pollutants are treated as though they were unreactive gases. Gravitational settling and dry deposition become increasingly important as the diameter of the particles exceeds about 10 μm and become critically important when the particle diameter exceeds 20 μm. Data from a number of studies indicate that typical fugitive dust sources are difficult to precisely identify and quantify. However, available data indicate that such emissions have a large proportion of mass in the range of 20-70+ μm. Therefore, application of conventional Gaussian plume models may be inadequate for air quality evaluation where fugitive dust is a significant problem.

Thus, there is an immediate need for an analytical technique by which States may quantitatively identify fugitive dust sources, assess their significance, and begin evaluating potential control measures. At the same time, the shortcomings of existing Gaussian dispersion models must be recognized. Ideally, one could adapt or modify the Gaussian models such as AQDM or CDM to explicitly consider fugitive dust sources and the mechanisms of gravitational settling and deposition (both dry and wet). Since these mechanisms are primarily a function of particle diameter and density, this would also require development of a detailed inventory which properly characterizes sources and stratifies emissions by particle size. By utilizing this "particle-sized" inventory with the modified model, one could derive source-receptor relationships to be used in evaluating alternative measures for control of fugitive dust and in planning SIP revisions.

As an interim approach, the technique developed by TRW based upon their work in Phoenix which is applicable to arid western locations is available. This technique used a modified Climatological Dispersion Model (CDM) to model fugitive dust emissions. Essentially, CDM is a regional model which accepts the emissions inventory in the form of gridded input. Long term concentrations are obtained by inputting the point frequency distribution functions of the surface winds. Turbulence is parameterized in terms of the standard Pasquill-Gifford Scheme. Recognition of the diurnal variation in mixing layer height is made by an algorithm which assigns a separate height for each stability class. Also, the variation in the horizontal wind with height is modeled according to the wind power law. Pollutant removal, by whatever means such as coagulation, sedimentation, Brownian diffusion, is handled only in a gross way through an exponential decay term.

CDM is useful for particles of a size governed primarily by dispersion forces, but not useful for the larger particles where gravitational settling becomes the dominant force. Because of the deposition problems associated with fugitive dust, it was necessary to treat emissions from local sources in the air quality modeling effort differently from those area wide sources with smaller particle sizes which CDM could represent accurately. To facilitate this modified modeling approach, the emissions model was altered so that it would prepare a gridded inventory for each of four particle size ranges. The particle size ranges were selected based on approximate cutoff points in dispersive behavior. The four size ranges are as follows: 0-10 microns; 11-20 microns; 21-70 microns; and greater than 70 microns. Although the inventory techniques are rudimentary, they do provide a first-approximation of the level and significance of various sources of fugitive dust. Thus, the TRW technique combines use of CDM (modified to account for deposition of 11-20 µm particles) with a parameterization of the air quality impact of particles larger than 20 µm using measured PM data and several key assumptions. The nature of these assumptions imposes severe limitations on the use of this technique as a predictive model. However, the TRW technique for western U.S. locations if properly applied can be useful to:

(1) Assess the relative importance of the fugitive dust problem.

(2) Assess the need for additional stationary source control in the context of the overall problem.

(3) Give a preliminary evaluation of the potential impact of various fugitive dust control measures. This evaluation could give a preliminary assessment of the likelihood of attainment/maintenance and an initial screening of those fugitive dust control measures which appear most promising for further evaluation.

Work is also progressing to refine techniques which will be applicable to those locations where the TRW technique may not be expected to yield adequate results, i.e., areas where traditional emissions are responsible for major air quality impact. Source receptor relationships incorporating findings from a GCA study of urban particulate problems have been investigated and additional guidance is available in that report (Volume III of reference 1 below).

REFERENCES AND ADDITIONAL INFORMATION -

(1) An Implementation Plan for Suspended Particulate Matter in the Phoenix Area, Volumes I-IV, (EPA-450/3-77-021a-d), Prepared for EPA by TRW, Redondo Beach, California, August 1977.

(2) Guidelines for Development of Control Strategies in Areas With Fugitive Dust Problems, OAQPS Guideline Series, OAQPS No. 1.2-071, Draft, April, 1977.

QUESTION - What techniques are available for fugitive emissions modeling?

ANSWER- Similar drawbacks to these just discussed for fugitive dust apply to modeling of industrial process fugitive particulate emissions techniques with respect to gravitational settling, dry deposition and wet removal of PM. Dispersion modeling, although usually less expensive than field measurements, has associated with it the problems of (1) inadequate handling of physical interferences, (2) lack of complete data needed for the model, and (3) lack of expertise in applying the model. all of which can lead to poor estimates. These general problems of modeling are compounded when dealing with fugitive emissions in a similar way to fugitive dust since: (1) the emissions are not well defined (by location or rate), and (2) where emissions are close to ground level, they may be effected by gravity and may disperse in a non-Gaussian plume.

An existing dispersion model is presently being modified to consider all fugitive emissions in an industrial complex and should be available by late fall 1977. A review of present techniques to assess the impacts of fugitive emissions can be found in Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions (EPA 450/3-77-010), March 1977. This document reviews state-of-the-art emissions measuring techniques and methods for determining empirical source-receptor relationships based on upwind-downwind monitoring programs. Simplified dispersion modeling techniques are presented for preliminary assessment of air quality impact in the short term. These techniques will not completely account for the complicating factors mentioned before such as multiple sources or non-Gaussian dispersion, but will help with estimates until the modified model is completed.

REFERENCES AND ADDITIONAL INFORMATION -

Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions, EPA 450/3-77-010, March 1977.

# VII

# QUESTIONS CONCERNING CONTROL TECHNOLOGY

QUESTION - What is "Reasonably Available Control Technology" (RACT) for stationary sources, and how is it determined for an individual source?

ANSWER - As part of the original SIP development in 1971 and 1972, the concept of RACT was expressed as a series of examples of emission limitations attainable by various source classes and was published in Appendix B of 40 CFR 51. This original concept is obsolete, for several reasons. First, it is now realized that the many individual physical specifications of plants cannot be covered by a rigid "one-number" approach. Controls that may be achievable for a source in one area may not be achievable for a similar source in another area because of variations in the process, the lack of space to retrofit the controls, the availability of complying fuels, or the like. In other instances, if an attempt is made to apply the same emission limit to all sources regardless of the specific situation, one may inhibit the application of better controls that may be quite achievable for a specific source at a specific location. Further, it is the air quality that determines the degree of control necessary in order to attain the NAAQS. Thus, similar sources may be treated differently in different areas because the reductions in air quality necessary to meet the NAAQS will vary, depending on the severity of the air quality problem. In some instances, the SIP may not require controls that are at the limit of achievable technology. Under the requirements of the Clean Air Act Amendments of 1977, controls must be applied at the level which will result in attainment before 1983. For these reasons, a flexible procedure for determining the RACT for various areas is appropriate.

With respect to individual point sources with defined emission points (i.e., those amenable to the application of control equipment) reasonably available control technology (RACT) defines the lowest emission limit that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility. RACT may represent a relatively stringent, or even "technology-forcing," requirement that goes beyond simple "off-the-shelf" technology. The determination of RACT will vary from source to source due to source configuration, retrofit feasiblity, operation procedures, raw materials, and other characteristics of an individual source or group of sources.

QUESTION - What guidance is available or is being prepared to assist in determining reasonable available control technology for specific sources?

ANSWER - Various efforts have either been completed or are underway to document reasonably available control technology for existing sources.

1. Technical support documents are available for those sources for which new source performance standards have been promulgated. Work

is continuing on the standards support and environmental impact statement documents (SSEIS) for many other sources. These SSEIS documents contain the results of technical investigations and the recommended NSPS. They serve as valuable reference documents in defining RACT for existing sources. It should be noted that similar technical support documents have been prepared for those sources affected by national emission standards for hazardous pollutants. To date such standards have been promulgated for asbestos, beryllium, and mercury and vinyl chloride. The technical support documents associated with these hazardous pollutant standards are also a source of information to assist in defining RACT.

2. A contract effort has been recently completed which defines available control technology for particulate matter from oil-burning boilers and furnaces. Control measures and procedures for reducing particulate emissions from oil-burning indirect heating plants are described for residential, commercial, industrial, and power plant sources. (Reference 1.)

3. A contract has been completed that describes available control technology for approximately 40 particulate matter source categories. The source categories are assessed according to (a) typical plant size and associated emissions, (b) applicable control equipment efficiency, and (c) potential for compliance with new source performance standards and the most and least restrictive SIP regulatory limitations. The document presents data typical of current emissions and control techniques. It is envisioned that this document will be useful for agencies faced with revising a SIP by identifying source categories where controls may be

tightened. Once these categories have been identified then other references should be employed to determine exactly how much additional control can be gained. (Reference 2.)

4. A contract effort has been undertaken to summarize all the available information concerning fugitive emissions and provide a guideline on its control for use by the states in the development of necessary revisions to the particulate matter control strategy. (Reference 3.)

REFERENCES AND ADDITIONAL INFORMATION -

(1) Control of Particulate Matter from Oil Burners and Boilers, EPA 450/3-76-005, April 1976.

(2) Controlled and Uncontrolled Emission Rates and Applicable Limitations for 80 Processes, Prepared for EPA by the Research Corporation of New England (TRC), Contract No. 68-02-1382, Sept. 1976.

(3) Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions, EPA 450/3-77-010, March 1977.

QUESTION - How significant are emissions from oil-burning facilities, and how can emissions from such sources be minimized?

ANSWER - In a recent study of particulate pollution in five cities in which more than one-third of the dwelling units used fuel oil, it was found that ambient particulate levels on an annual basis resulting from fuel oil combustion ranged from 8-13% of the mass on the hi-vol filter. The study further concluded that in midwestern cities, where coal is used significantly, even very major oil-fired combustion units, such as utility boilers, have in some cases been ignored as sources because they are cleaner than equivalent coal-fired units.

There is a significant range in the stringency of emission regulations applied to combustion sources in general, and one of the areas where there is room for further reductions in emissions is residential space heaters. Virtually all of these sources burn oil and are controlled only by visible emissions enforcement, if at all. The degree of which these sources contribute to the PM problem is not yet clearly defined.

Several control measures were evaluated for residential, commercial, industrial and utility size oil burners during a recent study, Control of Particulate Matter from Oil Burners and Boilers (EPA 450/3-76-005, April, 1976). The study contains an extensive review of the literature and presents possible particulate control measures for the residential, commercial, industrial and utility categories. As an example, possible control measures for utility size boilers and furnaces include such general approaches as improved burner servicing, equipment design changes, and fuel additives. Tables presenting similar information for residential, commercial, and industrial oil fired burners and boilers are included in the report.

REFERENCES AND ADDITIONAL INFORMATION -

(1) National Assessment of the Urban Particulate Problem, op. cit.

(2) Control of Particulate Matter from Oil Burners and Boilers, Prepared for EPA by the Acurex Corporation, Mountain View, California 94040, EPA 450/3-76-005, April 1976.

(3) Pace, T.G., "Impact of Energy Conversion Processes on Particulate Matter Air Quality," presented at 1976 Energy and Environment Conference, Cincinnati, Ohio.

QUESTION - Must any particular emission measurement test method be prescribed as the test method for determining compliance with State adopted emission limitations for particulate matter?

ANSWER - No. Under the State Implementation Plan process, States have the flexibility to determine the emission test method they will use to determine source compliance with adopted emission limitations. States, however, must define the specific test method which they will use to determine source compliance with adopted emission limitations. This is necessary for two reasons. First, it is necessary so that the anticipated emission reduction that will result from source compliance with the emission limitation can be determined to assess whether the control strategy is adequate to provide for attainment of national standards. Secondly, it is necessary to identify the specific test method because differences between test methods may allow more particulate matter emissions to be captured by one method versus another method. If the test method were not prescribed, then a conflict could exist as to whether test data using one method which showed compliance with the standard as more valid than test data using a second test method which indicated noncompliance with the emission limitation. In cases where States do not specifically identify a test method in their State Implementation Plan, EPA will use EPA emission test methods to determine emissions and source compliance, where necessary. 40 CFR 52.12(c) provides that "For purposes of Federal enforcement, emissions from sources subject to provisions of a plan which did not specify a test procedure. . .will be tested by means of the procedures and methods prescribed in the appendix to Part 60 of this title, and emissions from sources subject to approved provisions of a plan wherein a test procedure was specified will be tested by the specified procedure."

QUESTION - What potential control measures have been identified for construction sources?

ANSWER - The control of dust from construction activities is often approached through the use of "nuisance" or reasonable-precaution regulations. Control measures that can be applied include watering and chemical soil stabilization. Watering produces an average control efficiency of approximately 30%, and a 50% control efficiency is feasible with watering twice a day at the rate of 0.5 gallons per square yard. Chemical stabilization can produce a reduction of approximately 80% to 85% in emissions. Several commercial chemicals have demonstrated strong binding or crusting properties which are effective as long as the area is not exposed to traffic.

Another control measured to minimize emissions from construction activities is one of minimizing the exposure time that cleared earth may be exposed before construction activities begin. In some areas, there is a frequent practice of clearing vast plots of land many months before construction activities actually begin. Regulations which limit the exposure time can reduce fugitive dust emission in such cases.

Another control option includes reducing the amount of material from a construction site that may get on streets in the vicinity of the project where it can become resuspended. To minimize this problem, various control mechanisms are available. One way is to require all vehicles leaving the construction site to be cleaned in such a way that they will not carry out loose soil and deposit it on the streets. A second option is to require the operator of the construction site to frequently clean the streets in the vicinity of the project, perhaps daily.

REFERENCES AND ADDITIONAL INFORMATION -

(1) Investigation of Fugitive Dust, Volume I - Sources, Emissions, and Control, EPA 450/3-74-036a, June 1974.

(2) An Implementation Plan for Suspended Particulate Matter in the Phoenix Area (TRW, Inc.) Interim Report, Emissions Inventory, May 1976.

QUESTION - What control measures are available to minimize fugitive dust from unpaved roads?

ANSWER - Five control measures have been identified: paving, surface treatment with penetration chemicals, application of soil stabilization chemicals, watering, and traffic controls. Paving is the most expensive and effective measure, however, a benefit of paving is the elimination of routine maintenance costs for blading and regrading unpaved roads.

Initial surface chemical treatment for dust suppression is relatively inexpensive, but no treatment material has been found which remains effective for more than two months under normal traffic conditions.

Penetration chemicals, worked into the roadbed to a depth of two to six inches, are a good interim control measure, because they create a base for paving. The cost of this measure approaches the cost of paving.

Watering is not feasible because of the high frequency of treatment. In special cases, such as at construction sites, it may be appropriate.

Some comparisons of costs among various methods have been performed which address various options among paving and chemical stabilizing measures including various combinations of traffic control measures, as shown in the table below:

CONTROL TECHNIQUES FOR UNPAVED ROADS

| Control Method | Control Efficiency (%) | Cost ($) |
|---|---|---|
| Paving 3" bituminous surface | 85 | 20,000 - 26,000/mile |
| Paving, single chipseal on prepared roadbed | 50 | 8,500 - 14,000/mile/yr |
| Soil stabilization chemicals worked into the roadbed | 50 | 5,000 - 12,000/mile/yr |

Source: Investigation of Fugitive Dust, Volume I - Sources, Emissions, and Control, op.cit., pages 4-29.

Traffic controls have a negligible cost and can be effective. Controls on vehicle routing are more effective than speed controls, because emissions increase at a rate more rapid than increases in vehicle speed and vary in proportion to the number of vehicles on the road. Dust emissions increase exponentially with vehicle speed up to 30 mph. The table illustrates the dust emission rate at different speeds for a vehicle traveling over a typical dirt road in the Phoenix, Arizona, area. Restriction of traffic from unpaved roads is not feasible since almost all roads provide some necessary access.

DUST EMISSION RATE AT DIFFERENT VEHICLE SPEEDS

| Speed of Vehicle (mph) | Emission rate[a] (lb/vehicle mi.) | Degree of Emissions Reduction (%) |
|---|---|---|
| 35 | 22 | --- |
| 30 | 19 | 14 |
| 25 | 13 | 41 |
| 20 | 8.5 | 62 |

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[a] Based on exponential increase (to the power) in emissions from 0 to 30 mph, and linear increase above 30 mph. The base line emission rate (35 mph) was calculated, assuming the typical dirt road silt content of 24%. (Emission factor in Supp. 5, Compilation of Air Pollution Emission Factors, AP-42, p. 11.2.2).

For new roads, an effective control approach would be to require that all new roads be paved within an urban area. This would tend to minimize future growth of various fugitive dust sources.

REFERENCES AND ADDITIONAL INFORMATION -

(1) Investigation of Fugitive Dust, Sources, Emissions, and Control, Volume I, EPA 450/3-74-036a, June 1974.

(2) An Implementation Plan for Suspended Particulate Matter in the Phoenix Area, Draft Report, November 1976.

# VIII

# QUESTIONS CONCERNING THE CONTROL STRATEGY, ITS DEVELOPMENT, AND ITS REVISION

QUESTION - What consideration should be given to the control of automotive emissions in the control strategy?

ANSWER - Automotive emissions of PM can contribute approximately 3 to 5 $\mu g/m^3$ per cubic meter to ambient PM levels. Emission testing studies have shown that lead compounds comprise approximately one fourth of automotive exhaust particulates. Thus, one would expect that if lead levels in gasoline were reduced or non-leaded gasoline were used, a corresponding 20 to 30% reduction in PM should take place.

However, Page D-29 of Supplement Number 5 of AP-42 indicates that particulate emissions from automobile exhaust for leaded fuel are estimated at 0.34 grams/mile while estimates of unleaded fuel are estimated at 0.05 grams/mile. This represents an 85% reduction in particulate emissions due to the removal of lead from gasoline for light duty vehicles. These data appear contrary to the above information which indicates that lead comprises approximately one sixth of total exhaust particulate emissions from the automobiles. Other additives, such as bromine compounds, are introduced into leaded gasoline to scavenge lead oxides which deposit on an engine's pistons and cylinder walls. When lead is removed as an additive, therefore, not only are lead related particles removed, but these other compounds that also contribute to the particulate emissions are also eliminated.

Some independent test results have indicated that significant reductions in exhaust particles mass emissions were observed under all test conditions when tetraethyl lead and lead scavengers were removed from gasoline. A reduction of 77%* with non-leaded fuel was observed under stabilized operating conditions, although a range of 40% to 93% reduction was observed under various test conditions. Therefore, the 85% reduction in particulate emissions from the use of non-leaded fuels seems to be substantiated.

Consequently, when EPA regulations controlling the lead content in gasoline are implemented, a significant reduction in automotive emissions should result. These regulations will reduce the average lead in gasoline from the current level of approximately 2.0 grams per gallon to 0.5 grams per gallon by 1979. Further reductions of lead in gasoline should result as automobiles equipped with catalytic devices replace non-catalytic automobiles in use. Automobiles equipped with catalytic converters cannot use gasoline with high lead contents (in excess of 0.05 grams per gallon) since the lead would contaminate the catalytic device. Consequently, as more new cars equipped with catalysts replace non-catalyst equipped cars, automotive particulate emissions should be further reduced. These anticipated reductions in particulate emissions should be considered in SIP plan development.

EPA's suggested procedure for determining lead emissions from mobile sources will appear in the forthcoming publication, Supplementary Guidelines for Lead Implementation Plans, scheduled for publication around March 1978.

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* 200 test cycles were run in sequence. After the 30th test cycle, emission reductions of PM stabilized at approximately 77 percent.

REFERENCES AND ADDITIONAL INFORMATION -

(1) Lillis, E. and Dunbar, D., "Impact of Automotive Particle Exhaust Emissions on Air Quality," SIB, CPDD, OAQPS, November 13, 1975, unpublished paper.

(2) Supplement 5 for Compilation of Air Pollutant Emission Factors (Second Edition) (AP-42) OAQPS, April 1975.

(3) "Fuels and Fuel Additives - Control of Lead Additives in Gasoline," (41 FR 12675) Sept. 23, 1976.

QUESTION - What potential control measures have been identified for reentrained particulates?

ANSWER - Three control options which have been suggested include:

(a) Regulations which reduce the amount of material which gets onto streets,

(b) Increased and/or improved street cleaning procedures, and

(c) Reduction in vehicle miles travelled within areas affected by such problems.

While it is reasonable to regulate and prohibit material from getting onto streets, these measures are probably ineffective by themselves in resolving the problem. This is because they are generally temporary measures, such that control actions need to be implemented frequently. Furthermore, from an enforcement point of view they are generally resource-intensive and difficult to enforce. Street cleaning is another option frequently suggested; however, data are available which indicate that more particles may be available for resuspension after street cleaning than before when the most common operated brush type sweeper is used to clean streets. VMT reduction is theoretically available for application; however, it is an extreme measure to implement without first investigating the effectiveness of the other approaches. Also, no data are available that show that reductions in VMT will reduce PM levels. One study has suggested that the total air quality impact from resuspension may result from only a relatively small VMT, such that proportional reductions in VMT may not improve air quality accordingly. At the present time, an EPA study is under way in Kansas City to investigate various factors with regard to control of resuspended material has been completed. This study, Control of Reentrained Dust from Paved Streets, July 1977, is available through the EPA Library, Research Triangle Park, NC 27711.

REFERENCES AND ADDITIONAL INFORMATION -

(1) Dunbar, D., "Resuspension of Particulate Matter," Standards Implementation Branch, Control Programs Development Division, OAQPS, March 15, 1976, unpublished paper.

(2) National Assessment of the Urban Particulate Problem, op. cit.

QUESTION - What intergovernmental coordination and review are generally necessary in the development of SIP control strategies?

ANSWER - The Clean Air Act Amendments of 1977 require that strategies that contain transportation controls, air quality maintenance plans, or requirements for preconstruction review of new sources, or strategies pertaining to non-attainment requirements or prevention of significant deterioration must be reviewed under a process of consultation. This process of consultation must include local governments, designated organizations of elected local government officials and any Federal land manager with authority over land to which the State plan applies. Regulations governing the development of State plans of consultation will be promulgated by the Administrator by February 7, 1978. This new process of consultation will become effective for reviews conducted after August 7, 1978.

Presently, intergovernmental cooperation under 40 CFR 51.21 requires provisions for cooperation in interstate regions, and provision for cooperation among the various state and local agencies whose function affects, or is affected by the SIP revision.

Where the revision is developed under 40 CFR 51, Subpart D, several specific provisions for intergovernmental cooperation are required. These provisions appear under Section 51.58 - AQMA plan: Intergovernmental Cooperation. They are summarized as follows:

(1) Agency which is developing the SIP revision must be specified by the State.

(2) The developing agency must ensure the continuous involvement of other agencies whose function will be affected by the SIP revisions such as:

a. State Air Pollution Control Associations, Departments of Transportation, etc., local Air Pollution Control Districts.

b. Elected officials.

c. Agencies responsible for areawide waste treatment management planning under Section 208 of the Federal Water Pollution Control Act Amendments of 1972.

d. Other planning arms of the Federal government established in the Department of Housing and Urban Development, Department of Transportation, Office of Management and Budget, etc.

(3) The developing agency must coordinate with other planning bodies substantially affected by the SIP revision to develop a procedure for using common data bases, similar policy advisory bodies, public comment policy, etc.

(4) Where SIP revisions are being prepared for adjoining areas, such revisions must be coordinated.

(5) Office of Management and Budget A-95 review must be performed.

(6) The SIP revision must describe how the before mentioned coordination was and/or will be carried out.

(7) Public Participation must be provided for the development of the SIP revision.

Coordination with the agencies responsible for areawide waste treatment management planning under Section 208 of the Federal Water Pollution Control Act Amendments of 1972 is very important because EPA will not approve water quality management and air quality maintenance plans which are in conflict.

Although the above provisions are mandatory only for 40 CFR 51, Subpart D actions (Air Quality Maintenance Regulations), they represent an excellent guide to follow for all SIP control strategy revisions.

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(1) Maintenance of National Ambient Air Quality Standards - Summary (41 FR 18382), May 3, 1976.

(2) Briedenbach, W. and Strelow, R., Memorandum to All Regional Administrators, "Relationship Between Air Quality Planning and the State and Areawide Water Quality Management Program; Eligible Uses of Section 208 Funds for Air Quality Analyses," November 15, 1976.

QUESTION - How should secondary particulate matter be considered in a PM control strategy?

ANSWER - Secondary particulates can contribute up to 50 percent of the PM in an area. Knowledge of the relationship between the precursors of secondary particulates- sulfur oxides, nitrogen oxides, and organic compounds is limited. We do know that they are almost always fine, and the chemical composition of such fine particulates varies considerably from one geographic area to another. Table 4 illustrates this variation. It can be seen that the water soluble sulfates are the principal fine particulate component in the eastern United States, with organics and nitrates relatively more important in western areas.

A comprehensive study of PM problems in Los Angeles, California concluded that "To achieve the primary ambient air quality standards for particulate matter, effort must be continued to control $SO_x$, $NO_x$, and reactive hydrocarbon emissions from all sources..." Areas which have attainment/maintenance problems for PM should be aware that under certain environmental conditions, emissions of gases such as $SO_2$, $NO_2$, and

TABLE 4. Regional Variation Major Chemical Classes Typically Occurring as Fine Particulate (Annual Arithmetic Average Based on 1966-1968 NASN Data)

| Region | $SO_4^=$ [a] ($\mu g/m^3$) | BSO[b] ($\mu g/m^3$) | $NO_3^-$ [a] ($\mu g/m^3$) | Pb ($\mu g/m^3$) | Total ($\mu g/m^3$) |
|---|---|---|---|---|---|
| East[c] | 18.9 | 7.8 | 2.1 | 1.2 | 30 |
| Mideast[d] | 14.6 | 7.3 | 2.9 | 1.3 | 26 |
| South | 10.0 | 7.8 | 2.5 | 1.0 | 21 |
| Midwest[e] | 5.9 | 5.3 | 7.8 | 1.0 | 14 |
| Mountain | 3.4 | 4.7 | 1.3 | 1.3 | 10 |
| Southwest | 4.4 | 5.5 | 2.1 | 1.0 | 13 |
| West Coast | 9.4 | 8.9 | 3.8 | 1.9 | 24 |

[a] Measured $NH_4^+$ partitioned to $SO_4^=$, $NO_3^-$

[b] Benzene soluble organics, about 1/2 to 2/3 of total organics

[c] Providence, R.I. to Washington, D.C.

[d] Ohio, Michigan, Indiana, Illinois

[e] Minnesota, Iowa, Nebraska, Missouri

Source: A.P. Alshuller, Principal Species in Atmospheric Fine Particulate Matter, in Minutes of Meeting of U.S. EPA Agency Air Pollution Chemical and Physics Committee, Alexandria, Virginia. April 17-18, 1970. p. 15.

reactive hydrocarbons can result in the formation of sulfates, nitrates, and organic aerosols. Two approaches to the control of secondary particulates are (1) control of emissions of gaseous precursors to fine particulates which account for the majority of fine particulate mass, and (2) Control of the mechanisms which promote transformation of gases to particles. Gaseous substances are converted to secondary particulates by a number of uncompletely understood mechanisms which involve atmospheric variables such as levels of other pollutants, humidity, sunlight intensity, and temperature. Control of certain pollutants may slow these reactions and reduce the amount of gases which form particulates. For example, aerosol formation appears to be accelerated by photochemical activity. Hence, reductions in photochemical oxidant levels would indirectly influence secondary particulate levels by reducing the amount of gases which are transformed into aerosols. Since reactive HC emission reduction is the principal method of oxidant control, organic aerosols would be both indirectly and directly affected by oxidant reduction programs. Although some benefit can be expected from controlling pollutants which influence aerosol formation mechanisms, many other important variables, such as humidity, cannot be controlled. Thus, control of mechanisms which form particles in the atmosphere is likely to be a supplement to control of direct precursor gases, rather than a complete strategy. Additional understanding of aerosol formation mechanisms is needed.

Whenever possible in these non-attainment areas, the air quality samples should be chemically analyzed for secondary particulates. Where these concentrations are high, the control of precursors of secondary particulates should be considered in the control strategy.

REFERENCES AND ADDITIONAL INFORMATION -

(1) Steigerwald, B.J., Memorandum to Roger Strelow, "Fine Particulate Control Strategy," July 2, 1975.

(2) Padgett, J. and Bachman, J., "Regulatory and Technical Control Strategies for Fine Particles," Presented at the June 1976 APCA Meeting, Portland, Oregon, Paper No. 76-30.7.

(3) Hidy, G.M., Characterization of Aerosols in California, Final report to the Air Resources Board, State of California, Volumes 1-4, 1974.

(4) Position Paper on Regulation of Atmospheric Sulfates, EPA 450/2-75-007, September 1975.

QUESTION - How should fugitive dust sources be considered in the control strategy?

ANSWER - A fugitive dust policy has been developed. The recommended policy with regard to consideration of fugitive dust sources in SIP control strategy development is as follows:

1. The major emphasis for fugitive dust control will center upon urban areas. Rural areas should be encouraged to develop programs on a voluntary basis at this time where it is determined by measured air quality concentrations that some action may be desirable.

2. In urban areas, an analysis should be made to identify all sources of particulate matter and to consider various measures that might be used to reduce particulate emissions from both conventional stationary and fugitive dust sources and determine what the impact of such measures would have on ambient air quality. From this evaluation, an appropriate control program should be developed.

3. It is not recommended that unreasonable controls be implemented which would cause severe adverse social or economic disruption.

4. In urban areas, control of fugitive dust at construction activities is reasonably available and should be required if needed to meet national standards or minimize the ambient concentrations greater than national standards in urban areas. Also, reasonable efforts can be taken to stabilize cleared land awaiting construction. Similarly, it is generally reasonable in urban areas to control fugitive dust from demolition and similar activities, commercial driveways, parking lots, and truck parking areas. In urban areas where there is enough rain or water available, it may be reasonable to require owners of vacant lots to maintain some type of vegetative cover to minimize the potential for soil loss by wind erosion.

5. In urban areas, fugitive dust control measures such as street sweeping or street cleaning, paving of roads, stabilizing road shoulders and roadways, requiring that new roads be paved, and constructing curbs along roadways may be reasonable. Such measures should be considered by the State, where needed, and adopted when they can be successfully implemented.

6. At the present time, 208 water planning agencies are considering various techniques to minimize water runoff from "non-point sources" which are similar to fugitive dust sources. In particular, dust which collects on streets may be a water pollution problem as well as an air pollution problem. Coordination of air management planners with water management planners may be mutually benefical and is encouraged. See reference for additional information and page V-4 for a discussion of this coordination.

7. In urban areas where fugitive dust contributes to violations of national standards, existing stationary sources should generally be required to apply all reasonable measures to minimize emissions if they contribute significantly to the air quality levels in the area of question. In such areas, a case-by-case determination of needed controls for stationary sources within fugitive dust areas is in order. (Note: Thus all sources throughout an AQCR will not necessarily need to apply such measures, but only those sources within the particular geographic area where excursions of national standards occur and their impact is judged to be significant.)

8. The calls for SIP revisions in July 1976 set July 1978 as the deadline for submitting revisions to account for fugitive dust. Under the Clean Air Act Amendments of 1977, this date has been changed to January 1, 1979.

REFERENCES AND ADDITIONAL INFORMATION -

(1) Briedenbach, W., and Strelow, R., Memorandum to all Regional Administrators, "Relationship Between Air Quality Planning and the State and Areawide Water Quality Management Program; Eligible Uses of Section 208 Funds for Air Quality Analyses," November 15, 1976.

(2) "Fugitive Dust Policy: New Source Review," CPDD-OAQPS, August 1, 1977.

QUESTION - How should ambient data collected during dust storms and other unusual events be considered in a control strategy?

ANSWER - 40 CFR 51.12(d) provides that: "For purposes of developing a control strategy, data derived from measurements of existing ambient levels of a pollutant may be adjusted to reflect the extent to which occasional natural or accidental phenomena, e.g., dust storms, forest fires, industrial accidents, demonstrably affected such ambient levels during the measurement period." The rationale underlying this policy is the concept of "reasonableness" in control strategy development, in that strategies based on such unusual conditions would clearly be unreasonable.

REFERENCES AND ADDITIONAL INFORMATION -

Guidelines for the Interpretation of Air Quality Standards, OAQPS No. 1.2-008, February 1977, (Revised).

QUESTION - How does the EPA new source review emission offset policy affect SIP revisions?

ANSWER - The Clean Air Act of 1970 required State implementation plans (SIPs) to insure that National ambient air quality standards be attained not later than mid-1975 (or 1977 if an extension has been granted). Since the statutory attainment dates established by the 1970 Act, have already pased and the ambient standards have not been attained in many areas of the country, questions have arisen as to whether and to what extent new sources may legally be permitted to construct in these areas. In answer to this question EPA has developed an "emission offset" policy. Essentially, this policy would allow construction of major new sources in areas of nonattainment if, in the area of the proposed source, emission reductions are obtained such that the total emissions from existing and proposed sources are significantly less than emissions in the area prior to construction of the new sources. This result might be reached by "offsetting" reductions in emissions from existing sources for the emissions of the new source, i.e., more stringent control of existing facilities.

The Clean Air Act Amendments of 1977 will change the use of the offset policy before July 1, 1979. The offset policy may be waived by the Administrator for any pollutant if the State review program meets requirements as stated in the amendments. These requirements include an inventory of emissions, an enforceable permit system which has emission limitations and control on existing sources incorporating reasonably available control technology as a minimum, and a program to reduce emissions prior to January 1, 1979, to provide reductions equivalent to the reductions possible under the offset policy. This waiver can be terminated by the Administrator if the requirements are not met.

For the period after July 1, 1979, the new Act requires as a precondition for the construction or modification of major stationary sources in nonattainment areas that SIPs in nonattainment areas provide for attainment as expeditiously as practicable but not later than December 31, 1982, for the primary standards. There are also additional requirements specified in the Act for a new or modified major stationary source to obtain a permit after July 1, 1979. These requirements appear in Section 173 of the Act.

REFERENCES AND ADDITIONAL INFORMATION -

(1) Steigerwald, B.J., Memorandum to All Regional Administrators "Meeting to Discuss EPA New Source Review Policy in Non-Attainment Areas," October 28, 1976.

(2) "Air Quality Standards; Interpretative Ruling", (41 FR 55525), December 21, 1976.

QUESTION - How should the impact of stationary fuel switches under the Energy Supply and Environmental Coordination Act of 1974 (ESECA) be considered in control strategy development?

ANSWER - Under ESECA, the Federal Energy Administrator (FEA) has authority to order facilities to switch from oil or gas to coal, but any such order shall not become effective until EPA certifies that such plan or installation will be able to comply with the applicable air pollution requirements. These requirements are the applicable State Implementation Plan (SIP). In practice, EPA requires, in 40 CFR 55.06(a), that sources ordered to convert to coal submit to EPA (1) "A certification of the date that the source will be able to burn coal and comply with all applicable air pollution requirements," and (2) a plan for compliance which includes the necessary steps the source must take to comply with all applicable air pollution requirements." Even if the affected facility is in an area estimated to be a "nonattainment" area and/or is in an area covered by a SIP which is suspected to be or declared to be "substantially inadequate," the only requirement which must be met is the applicable SIP.

Therefore, if a fuel conversion under ESECA is expected to be ordered in the area of concern for the control strategy, the strategy developer must evaluate the expected increase in emissions which will result from the conversion on a case-by-case basis and adjust the overall strategy accordingly. Where the conversion causes a violation of the NAAQS, a SIP revision would be called. This revision would be handled like any other SIP revision.

In addition, the Clean Air Act Amendments of 1977 require States to review the effects of fuel conversion in preparation for the SIP revisions due in January 1979.

REFERENCES AND ADDITIONAL INFORMATION -

Energy Supply and Environmental Coordination Act of 1974 (ESECA), Public Law 93-319, 93rd Congress, H.R. 14368, June 22, 1974.

QUESTION - What is the effect of malfunctions or breakdowns of control equipment on ambient air quality and what is the present policy in handling such periods in a control strategy?

ANSWER - Studies have indicated that under certain conditions a malfunction or breakdown will effect ambient air quality. Present policy toward including such periods as violations under enforcement provisions shall be continued.

In the decision, as to whether notices of violation issued under such conditions would be followed by any other action, the agency would look at the following conditions stated in the April 27, 1977 Federal Register (42 FR 21473):

(1) The air pollution control equipment process equipment or processes were at all times maintained and operated, to the maximum extent practicable, in a manner consistent with good practice for minimizing emissions.

(2) Repairs were made as expeditiously as practicable including the use of off-shift labor and overtime.

(3) The amount and duration of the excess emissions were minimized to the maximum extent practicable during periods of such emissions, and

(4) Bypass of strong $SO_2$ streams around acid plants was limited to the maximum extent practicable.

If these conditions were met then it is present policy not to proceed with the implementation of criminal penalties.

There are many different State controls for malfunction or breakdown occurences, but there is no uniform manner to incorporate them into one control strategy for PM.

REFERENCES AND ADDITIONAL INFORMATION -

Assessment of Particulate Attainment and Maintenance Problem, Vol. 1, Appendix A (GCA Report) Sept. 1976.

# IX

## GLOSSARY

Aerosol - A dispersion of solid or liquid particles of microscopic size in a gaseous medium, such as smoke, fog or mist.

Affected Facility - With reference to a stationary source, any apparatus to which a standard is applicable.

Air Quality Control Region (AQCR) - The basic geographic area on which air pollution control strategies are formulated. The AQCR boundaries are designated as much as possible to be consistent with the air shed concept. That is, the sources in a given area theoretically share a common air mass and the air quality is a result of the emissions contribution of all the sources in a given area. EPA, assisted by the States, has devided the country into 247 AQCRs. A region may cover only part of one State or it can include portions of several States which share a common air pollution problem.

Air Quality Maintenance Plan (AQMP) - A control strategy designed to ensure that once an air quality standard is attained, pollutant levels will not increase to levels that would again exceed the prescribed air quality standard. An AQMP is part of the State Implementation Plan.

Background Concentration or Background Level - Ambient concentrations which are caused by natural sources of pollution. In some cases, background may also include man-made pollutants advected into the area. Background is often used to denote those concentrations which are uncontrollable, either because they are of natural origin or because they are transported from another area not subject to the jurisdiction of the air pollution control agency.

Best Available Control Technology (BACT) - The best available control technology means an emission limitation based on the maximum degree of reduction of each pollutant subject to regulation emitted from any major emitting facility, taking into account energy, environmental, and ecnomic impacts.

Control Strategy - Those activities and functions within a broader program of air resource management that collectively are directed toward the reduction of excessive emissions of pollutants; the regulatory aspects of an air resource management program.

Emission Factor - An estimate of the rate of which a pollutant is released to the atmosphere as a result of some activity such as combustion or industrial production, divided by the level of activity.

Emission Standard - A part of a legally enforceable regulation setting forth an allowable rate of emissions into the atmosphere or prescribing equipment specifications for control of air pollution emissions.

Fugitive Dust - A type of particulate emission made airborne by forces of wind, man's activity or both, such as unpaved roads, construction sites, tilled land, or windstorms.

Fugitive Emissions - Particles which are generated by industrial or other activities and which escape to the atmosphere not through primary exhaust systems, but through openings such as windows, vents or doors, ill-fitting oven closures, or poorly maintained equipment.

Ground Level Concentration - The mass per unit volume of solid, liquid, or gaseous material in micrograms per cubic meter of air, measured from 0 to 2 meters above the ground.

High Volume Sampler (Hi-Vol) - A device for collecting fine suspended particulate matter by drawing air through a filtering medium. The Federal Reference Method for Total Suspended Particulates.

Model/Modeling - A mathematical or physical representation of an observable situation. In air pollution control, models afford the ability to predict pollutant distribution or dispersion from identified sources for specified whether conditions.

National Ambient Air Quality Standards (NAAQS) - A legal limit on the level or atmospheric contamination necessary to protect against adverse effects on public health and welfare. Primary standards are those related to health effects. Secondary standards are related to protection against adverse welfare effect.

Opacity - The degree to which emissions reduce the transmission of light and obscure the view of an object in the background.

Particle Size Distribution - The relative percentage of weight or number of each of the different size fractions of particulate matter.

Re-Entrainment - The resuspension in the atmosphere of particles from streets, rooftops, etc., by wind, passing vehicles, or other such forces.

Reference Conditions - EPA requires that all measurements of air quality be corrected to a reference temperature of 25°C and to a reference pressure of 760 millimeters of Hg (1,013.2 millibars).

Settleable Particulate - Particulate matter which is emitted into the atmosphere such that it may deposit onto horizontal surfaces due to gravitational settling.

State Implementation Plan (SIP) - A document prepared by each State, as required by the Clean Air Act, describing existing air quality conditions and setting forth a program to attain and to maintain National Ambient Air Quality Standards and prevent significant deterioration of air quality.

Suspended Particulate - Particulate matter which will remain airborne for an appreciable period of time.

Source: Glossary derived from Appendix A of Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions Prepared by PEDCo Environmental, Inc., Cincinnati, Ohio, EPA 450/3-77-010, Contract No. 68-02-1375.

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"Emission Monitoring of Stationary Sources," (40 FR 46240), Oct. 6, 1975.

"Emission Monitoring Requirements and Revisions to Performance Testing Methods," (40 FR 46250), Oct. 6, 1975.

(40 FR 43850), Sept. 23, 1975, 40 CFR 60.273.

(41 FR 18502), May 4, 1976, 40 CFR 60.264.

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